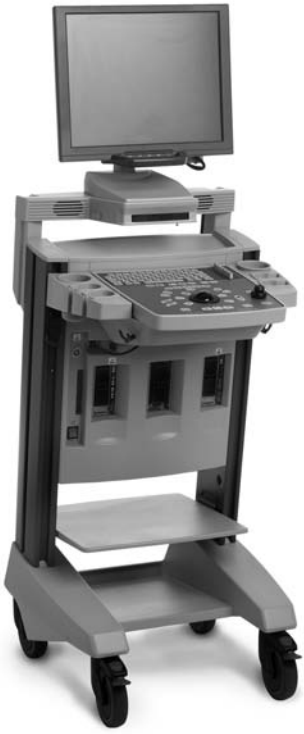
Falcon Premium
Extended User Guide

Type 2101 EXL



English
BB1737-A
October 2007

CE 0543

we specialize because you do

WORLD HEADQUARTERS
Mileparken 34
DK-2730 Herlev
Denmark
Tel.:+45 44528100 / Fax:+45 44528199
www.bkmed.com
Email: info@bkmed.dk

B-K Medical Customer Satisfaction

Input from our customers helps us improve our products and services. As part of our customer satisfaction program, we contact a sample of our customers a few months after they receive their orders. If you receive an email message from us asking for your feedback, we hope you will be willing to answer some questions about your experience buying and using our products. Your opinions are important to us. You are of course always welcome to contact us via your B-K Medical representative or by contacting us directly.

Scanner Software

The Falcon Premium 2101EXL Ultrasound Scanner is closed. Any modification of or installation of software to the system may compromise safety and function of the system. Any modification of or installation of software without written permission from B-K Medical will immediately void any warranty supplied by B-K Medical. Such changes will also void any service contract and result in charges to the customer for restoration of the original Falcon Premium 2101EXL system.

© 2007 B-K Medical
Information in this document may be subject to change without notice.

Contents

General Information A

Operation B

Urology Calculations C

Cardiac Calculations D

Obstetrics Calculations E

M-mode Calculations F

Care of the Scanner G

Installation H

Appendices

1. Keyboard Shortcuts and Functions
2. Setup Overview
3. Urology Calculation Methods
4. Cardiac Calculation Methods
5. Obstetrics Calculation Methods

Index

Falcon Premium Front Panel

This control is inactive

About this Guide

This user guide is for the Falcon Premium 2101EXL Ultrasound Scanner. The scanner is a 2D ultrasound echo and flow imaging system for diagnosis, data processing and transfer and guidance of puncture and biopsy. It is not for continuous operation. This means that we recommend that you turn off the scanner at the end of each workday.

Specifications for the scanner can be found in the Product Data sheet (BP0127) that accompanies this user guide.

Before using the scanner, please make yourself familiar with the operating instructions in this guide and in the *Transducer Care, Cleaning & Safety* manual.

NOTE: *Some of the functionality and options described in this guide may not be available with your version of the scanner.*

Make sure that you also read the transducer user guide and specifications for each transducer that you use. The transducer user guides contain specific information about operating and caring for each transducer. Acoustic output data and data about EMC (electromagnetic compatibility) for all transducers used with this scanner are on the Technical Data CD (BZ2100) that accompanies this user guide.

This section contains important safety information that you should be aware of before you use the scanner. The rest of the book also contains safety information.

The information in this user guide is divided into SECTIONS A to H and Appendices 1 to 5. Each section has its own table of contents which is printed on a section divider.

In the front of this book you will find an overview of the front panel which may be helpful to look at whilst you read this user guide.

October 2007

Information in this document may be subject to change without notice

Safety Information

This user guide contains cautions, warnings and other information about what you must do to ensure the safe and proper performance of the ultrasound scanner. You must also follow local government rules and guidelines at all times.

WARNING

Warnings contain information that is important for avoiding personal injury.

Caution:

Statements that are marked in this way provide information and instructions that must be followed to avoid damaging equipment, data or software.

Scanner

Important safety information is indicated on the scanner by means of special symbols. Fig.1 contains brief explanations of the safety symbols used to label the scanner.

Note especially the following:

⚠ When you encounter this sign on the scanner, consult the user guide for important safety information.

B-K Medical disclaims all responsibility for the operating safety, reliability and performance of the equipment if these symbols and warnings are disregarded in any way.

Symbol	Name	Description
	Caution or Warning	Consult accompanying user guide (BB 1086) when you encounter this sign on the instrument, to avoid reducing its safety
	Potential Equalization	Terminal connected to the chassis. Should be connected to corresponding terminals on other equipment to eliminate potential differences.
	Ground (earth)	Additional protective ground (earth).

Symbol	Name	Description
	Protective ground (earth)	Protective ground
	Type BF	BF: Isolated from ground. Maximum patient leakage current under: Normal Condition ≤100 µA, Single Fault Condition ≤500 µA
	Type BF	BF, defibrillator-proof
	Type B	B: Maximum patient leakage current under: Normal Condition ≤100µA, Single Fault Condition ≤500µA
IP	SEALING	Dust-and-immersion-protected according to IEC Publication 60529 [1]
	Standby	Use this switch to turn the scanner on and off.
	Non-ionizing radiation	Ultrasound scanner emits acoustic radiation
	STERILE	Device is in a sterile condition
	Not watertight	Plug may not be immersed (unless it is covered with a special water-tight plug cover).
	ESD (electrostatic discharge)	Do not touch pins in connectors with this symbol unless you follow ESD precautionary procedures.
	WEEE waste	Within the EU, when you discard the equipment, you must send it to appropriate facilities for recovery and recycling.

Fig. 1. IEC and EC symbols on the scanner

CE Marks on Electrical Devices

The European Union has introduced directives requiring CE marks on devices.

Non medical devices marked with CE comply with relevant directives, for example EEC Council Directive 89/336/EEC of 3 May 1989 concerning Electromagnetic Compatibility.

B-K Medical devices marked with CE or CE 0543 comply with EEC Council Directive 93/42/EEC of 14 June 1993 concerning Medical Devices. CE applies to Class I medical devices. CE 0543 applies to Class Im, IIa, IIb and III. B-K Medical defines classes assuming scanning duration for individual patients does not exceed 60 minutes.

General Safety Precautions

The ultrasound scanner is designed and tested in accordance with EN/IEC 60601-1 [2] and EN 60601–2–37 [3]. It complies with requirements for Class 1 (protective earth) devices of EN/IEC 60601-1 [2]. It also complies with UL 2601-1 [4] and CSA C22.2 No. 601.1–M90 [5]. It fulfills the requirements for dust protection (IP20) for ordinary equipment specified in EN 60529 [1].

WARNING

Federal law in North America restricts this device to sale to, or on the order of, a physician.

Caution

Large variations in temperature or humidity may cause water to condense inside the scanner. If this happens, the scanner may fail to operate properly. Always let the scanner come to room temperature before you turn on the power switch.

- *Wait at least 2 hours after the scanner has been subjected to major changes in temperature or humidity.*
- *If there is visible evidence of condensation, wait at least 8 hours.*

WARNING

If at any time the scanner malfunctions or the image is severely distorted or degraded, or you suspect in any way that the scanner is not functioning correctly:

- *Remove all transducers from contact with the patient.*
- *Unplug the scanner from the wall and make sure it cannot be used until it has been checked.*
- *Do not remove the scanner cover.*
- *Contact your B-K Medical representative or hospital technician.*

WARNING

The power supply cord connects the scanner to the line voltage. To isolate the scanner, you must unplug the power supply cord from the wall outlet.

Before you use the scanner, make sure that all the safety requirements described in this section have been satisfied.

Explosion Hazards

WARNING

The ultrasound scanner is not designed to be used in potentially explosive environments. It should not be operated in the presence of flammable liquids or gases, or in oxygen-enriched atmospheres.

There is a possible explosion hazard if the scanner is used in the presence of flammable anesthetic. The scanner should be placed at least 25cm (10 inches) from the patient.

The ultrasound scanner contains a lithium battery. Never remove or replace this battery. The lithium battery must not be removed except by a B-K Medical service representative.

Electrical Safety

WARNING

Do not plug the scanner into an ordinary power strip. If the ground connection fails, this is dangerous because

- *the total leakage current for all the connected equipment can exceed the limits specified in EN/IEC 60601-1 [2].*
- *the impedance of the ground connection will probably also exceed the limits specified in EN/IEC 60601-1.*

WARNING

When the equipment is used with 230V (and you believe the leakage current would be within the UL limit if you were using 120V), power to the equipment must come from an installation or supply with a center-tapped, 240V single-phase circuit. This will make sure that chassis leakage current during single fault condition fulfills the requirements specified in UL2601-1 [4] (limit of 300µA). If power is not supplied in the way specified, the leakage current can be as high as 500µA, the limit specified in EN/IEC60601-1.

WARNING

Never remove the cover to get access to the inside of the scanner. You risk electrical shock if you do so. Do not allow anyone but qualified service personnel to service the scanner.

Anyone using the equipment must be able to recognize the ESD symbol and understand how to take the necessary precautionary procedures, as described in the warning below.

WARNING

Do not touch pins in connectors that have this symbol. Do not connect anything to them unless you follow these ESD (electrostatic discharge) precautionary procedures:

Discharge your body to ground before you touch the pins with your hand or a tool. For example, touch an unpainted metal part of the scanner cover.

You can use a wrist strap connected to the additional protective ground or potential equalization terminal on the scanner if that is more convenient.

Installation

WARNING

To ensure safe performance, a qualified electrical engineer or hospital safety personnel must verify that the ultrasound scanner is correctly installed and that it complies with the safety requirements described below:

- *Use only the original power cable. This must be fitted with a hospital-approved three-prong grounded power plug. See Section H "Installation".*
- *The equipment must only be connected to a grounded AC power supply (or wall outlet) that meets EN/IEC/NEC requirements or applicable local regulations. The examination room's grounding system should be checked regularly by a qualified electronics engineer or hospital safety personnel.*
- *Make sure that the main voltage selector on the back of the scanner is set to match the available AC line voltage. See Section H "Installation".*
- *Make sure that fuses for the available power supply voltage are installed.*
- *Never use extension cables. The increased length of the cable will increase the resistance of the protective ground conductor beyond an acceptable level.*
- *Keep power cables, sockets and plugs clean and dry at all times.*

Interference

The Falcon Premium 2101EXL Ultrasound Scanner is suitable for use in all establishments, other than domestic establishments and those directly connected to the public low-voltage power supply network that supplies buildings used for domestic purposes.

Electrical noise

WARNING

Electrical noise from nearby devices such as electrosurgical devices – or from devices that can transmit electrical noise to the AC line – may cause disturbances in ultrasound images. This could increase the risk during diagnostic or interventional procedures.

Electromagnetic Interference

Medical electrical equipment requires special precautions regarding EMC (electromagnetic compatibility) [6]. You must follow the instructions in this chapter when you install the scanner and put it into service.

If the image is distorted, it may be necessary to position the scanner further from sources of electromagnetic interference or to install magnetic shielding.

WARNING

Do not use this equipment adjacent to other equipment. If you must place it next to or stacked with other equipment, verify that it operates normally there and neither causes nor is affected by electromagnetic interference.

EMC noise can reduce the usable image depth. Therefore, in order to avoid having to repeat an ultrasound examination, you must make sure beforehand that the ultrasound system can be used for the examination. Repeating an examination can be regarded as a potential risk that should be avoided, especially if the examination involves transducers used intracorporeally or transducers used for puncture.

RF (Radio Frequency) Interference

Portable and mobile RF (radio frequency) communication equipment can affect the scanner, but the scanner will remain safe and meet essential performance requirements.

An ultrasound scanner intentionally receives RF electromagnetic energy for the purpose of its operation. The transducers are very sensitive to frequencies within their signal frequency range (0.5 MHz to 35 MHz). Therefore RF equipment operating in this frequency range can affect the ultrasound image. However, if dis-

turbances occur, they will appear as white lines in the ultrasound picture and cannot be confused with physiological signals.

WARNING
Other equipment may interfere with the scanner, even if that other equipment complies with CISPR (International Special Committee on Radio Interference) emission requirements.

WARNING
If you use accessories, transducers or cables with the scanner, other than those specified, increased emission or decreased immunity of the system may result.

Transducers

WARNING
The transducer sockets contain terminals with 5V/12V. Do not touch the patient while you are touching an uncovered socket.

WARNING
When using Type B (non-isolated) transducers, carefully check all electrical equipment within the patient area. Also, consider using additional protective grounding.

WARNING
Do not leave transducers in contact with the patient when using HF electrosurgical equipment.

B-K Medical transducers fulfill EMC requirements when they are outside as well as inside the patient's body.

Please refer to the *Transducer Care, Cleaning & Safety* manual for information about caring for transducers.

Other Safety Considerations

Mechanical failure or unintended use of ultrasound equipment can result in physical injury to patients or operators.

WARNING

Be careful to avoid the following potential sources of injury:

- *Parts of the body can be pinched by moveable parts of the scanner, such as the front panel, and the monitor.*
- *Tilting the scanner can cause it to be unstable and injure someone.*
- *Do not lean or sit on the front panel. The front panel or monitor can break if subjected to heavy weights or impact.*

Service and Repair

WARNING

Service and repair of B-K Medical electromedical equipment must be carried out only by the manufacturer or its authorized representatives. B-K Medical reserves the right to disclaim all responsibility, including but not limited to responsibility for the operating safety, reliability and performance of equipment serviced or repaired by other parties. After service or repairs have been carried out, a qualified electrical engineer or hospital technician should verify the safety of all equipment.

Connecting Other Equipment

WARNING

Consult this user guide before connecting other equipment to terminals marked with ⚠ *.*

To fulfill EMC requirements, do not attach cables to the scanner unless they are the same type as listed in Fig. H3, page H-5 and do not exceed the maximum length given in the table. Do not attach transducers and other accessories unless the user guide for the transducer or accessory states that it can be used with this scanner. Attaching other equipment may cause an increase in electromagnetic emissions or may cause the scanner to be more sensitive to electromagnetic interference.

WARNING

Equipment that complies with the requirements of EN/IEC 60601–1 [2], UL 2601-1 [4] or CSA C22.2 No. 601.1–M90 [5] can be connected to the scanner, but the power for the equipment must come from the auxiliary power output on the scanner or from an independent wall power outlet. You can use the isolated auxiliary power outlets on the scanner to connect equipment such as a monitor or video printer requiring a total of 300VA or less. Otherwise, you can plug the scanner and other equipment into an external common isolation transformer in order to control the leakage current during a ground connection fault. Follow the guidelines in EN60601–1–1 [7]. If in doubt, contact your local B-K Medical representative.

WARNING

If you connect non-medical equipment (instruments that do not comply with safety requirements for medical equipment), this equipment must be placed outside the patient environment (1.5m from the bed, for example). The equipment must fulfill the relevant EN standard or other applicable national or international standard.

The power for the equipment must come from the auxiliary power output on the scanner. You can use the isolated auxiliary power outlets on the scanner to connect equipment such as a monitor or video printer requiring a total of 300VA or less. Otherwise, you can plug the scanner and other equipment into an external common isolation transformer in order to control the leakage current during a ground connection fault. Follow the guidelines in EN60601–1–1 [7]. If in doubt, contact your local B-K Medical representative.

Acoustic Output

General

Medical research has yet to prove whether or not ultrasound causes biological effects. Therefore prudent use considerations require you to follow certain guidelines [3].

Prudent Use

WARNING
Always keep the exposure level (the acoustic output level and the exposure time) as low as possible.

- Scan patients only when clinical reasons make it necessary.
- Keep exposure time as short as possible.
- Be careful to prepare the patient correctly so that you get the best possible image.
- Start scanning at a low acoustic output level (see Thermal and Mechanical Indices) and increase the level only as much as necessary to obtain a satisfactory image.
- If you switch from an application requiring high acoustic output levels, to one that requires lower levels (fetal scanning, for example), be sure to reset the levels before you scan. (For example, start in B-mode.)
- Take into account all the types of tissue that may be affected. For example, when scanning a breast, it may be appropriate to monitor the TI in bone rather than in soft tissue because the ribs will be subjected to ultrasound.

WARNING
Before attempting to use B-K Medical equipment, you should be trained in ultrasonography or be under the supervision of someone who is trained in ultrasonography. You should also be thoroughly familiar with the safe operation of your ultrasound system and should always use the transducer best suited to the examination.

Acoustic output data and data about EMC (electromagnetic compatibility) for all transducers used with the ultrasound scanner are given in a CD (BZ2100) that accompanies this user guide. For definitions of the parameters, refer to the Food and Drug Administration (FDA) Guide [8] as well as EN 60601-2-37 [3] and AIUM/NEMA standards [9,10].

In North America, the FDA requires all ultrasound equipment to be cleared before sale in the United States.

The routes (or tracks) available for clearance by FDA are well-defined. Track 3 is for diagnostic ultrasound systems that follow

the Output Display Standard. Under Track 3, acoustic output will not be evaluated on an application-specific basis, but the maximum derated Spatial Peak–Temporal Average Intensity (I_{SPTA}) must be ≤720 mW/cm^2, the maximum Mechanical Index (MI) must be ≤1.9, and the maximum Thermal Index (TI) must be ≤6. All B-K Medical transducers for use with the scanner are Track 3.

Monitor Display

The Mechanical Index (MI) and Thermal Index (TI) can be viewed in all scanning modes.

For mechanical transducers, MI is shown while scanning in B-mode.

Thermal and Mechanical Indices

The MI and TI indices are intended to allow users to implement ALARA [11, 12] (as low as reasonably achievable) using an indicator related to a potential bioeffect.

The full details of the indices are given in references [3] and [10], but can be summarized as follows.

$$MI = \frac{P_{r0,3}(z_{sp})}{\sqrt{f_c}}$$

where:

$P_{r0.3}(z_{sp})$ = the Peak Rarefactional Pressure (MPa), derated by 0.3 dB/cm-MHz to the point on the Beam Axis, z_{sp}, where Pulse Intensity Integral ($PII_{0.3}$) is maximum,

and

f_c is the measured center frequency (MHz).

$$TI = \frac{W_0}{W_{deg}}$$

where:

W_0 is the time-averaged acoustic power of the source or other power parameter (W)

and

W_{deg} is the estimated power necessary to raise the temperature of the target tissue one degree Celsius (W/°C).

As a rule of thumb, the Thermal Index (TI) indicates the highest expected temperature increase in degrees Celsius. It is based on an average level of blood perfusion. The displayed TI may underestimate the temperature rise in poorly perfused tissues; you must take this into account when deciding on the maximum TI you will allow. Conversely, in areas with a rich perfusion of blood the temperature increase will be less than the displayed TI indicates.

Note that a one degree Celsius increase in a patient with fever may cause complications in certain circumstances; it may be safer to delay the investigation.

Acoustic Output Measurement

All values are measured in water according to the EN and AIUM/NEMA display standards [3, 9, 10]. For the I_{SPTA} and MI, an estimated in situ derated value is given. This is derived assuming a tissue attenuation of 0.3 dB/cm/MHz when the estimated in situ derated value (I) is described by the following equation:

$$I = I_w exp(-0{,}069fz)$$

where

I_W is the Intensity in water at the position where I is maximum,

f is the transducer frequency (MHz), and

z is the distance (in cm) from the transducer face to the position where I is maximum.

It should be stressed that the in situ values given are only applicable when there is attenuating tissue between the transducer face and the focal point.

Possibility of Adverse Effects

Although it is believed that diagnostic ultrasound causes no significant biological effects in mammalian tissue [3, 10], the user should be aware of the hypothetical possibilities of adverse effects [11, 13, 14].

Current scientific and clinical concern over possible adverse effects is particularly focused on fetal ultrasound scanning. It is due to the increased sensitivity of mammalian cells and organs at this phase of their development and the fact that such a risk could have profound implications on public health. If you use high acoustic output levels for some reason, be sure to return to B-mode alone and turn down the power level before you do any fetal scanning.

Controls Affecting Acoustic Output

The scanner has a control function which ensures that neither the I_{SPTA} nor MI value exceeds the maximum allowable value. When necessary, the scanner will reduce the output voltage and PRF (pulse repetition frequency) to the transducer in order to comply with requirements.

Some controls on the scanner can affect the acoustic output, as listed here. (Instructions for using these controls are given in sections A and B of this user guide.)

- Size controls - in general, smaller size results in higher acoustic intensity.
- Zoom - in general, smaller zoomed area results in higher acoustic intensity due to higher pulse repetition frequency or stronger focus.
- Strong focus - in general, selecting strong focus results in higher acoustic intensity.
- Frame Rate - higher frame rate results in higher acoustic intensity.

The user can set a Thermal Index Limit which will set the highest expected temperature increase in degrees Celsius. This will provide an upper limit for acoustic output.

Default Acoustic Output

After the scanner has been switched off, the transducers will start in the default setup when the scanner is turned on again.

The factory-defined default setup values of acoustic output for each transducer are listed on the Technical Data CD (BZ2100).

These setups have been optimized to give the best compromise between low acoustic output and enough power to obtain the image features as quickly as possible. This is part of the ALARA principle. The factory default setup for all transducers is B-Mode to ensure the lowest acoustic output when you start scanning.

To change the default setup to another that satisfies the ALARA principle, see Setup in Section A.2. However, the default setup of B-Mode cannot be changed by the user.

When you enter a new patient ID, the transducer setup will be reset to the default setup, unless **Partial Reset** is activated (see Section A.3). When the **Partial Reset** button is used, the scanning mode will be set to B-Mode and all the measurement data will be reset, while the rest of the settings remain the same.

When you use transducers intended for fetal Doppler scanning, it is important to make sure that the default settings are appropriate and to reset to the default setting before scanning a new patient.

Clinical Measurements: Ranges and Accuracies

This section states the accuracies for measurements made using the B-K Medical range of ultrasound scanners. A table containing accuracies for specific transducers can be found on the Technical Data CD (BZ2100) that accompanies this user guide.

The measurement accuracies are based on the assumption of “ideal” tissue, that is, a tissue characterized by a sound velocity of 1540 m/s. When making clinical measurements with ultrasound, errors may arise which are not taken into account in this section. For example:

- the sound velocity may vary from approximately 1450 m/s in fatty tissue to 1585 m/s in muscle. This can, in simple cases, give rise to errors of up to 6% for linear measure-

ments. This inaccuracy may be further increased by refraction occurring at tissue boundaries.

- the user can introduce errors when using approximate formulas, when positioning the system's calipers with respect to the ultrasound image and when outlining structures in the image.
- the ellipsoid volume approximation, described in the scanner user guide, is only applicable when the cross section of the structure being studied approximates an ellipse (the circle being a special ellipse), and when the structure is roughly symmetrical about the selected axis of rotation.

Note: The choice of the axis of rotation is important for the calculation of the volume. A vertical axis gives a different volume than a horizontal axis. For more information on the effect of the rotation axis angle on volume determination, see Fig. B7 on page B-10.

The minimum requirement is that the cross section outlined by the user should be convex. If the user draws a non-convex outline, an inaccuracy is introduced which is not taken into account in this section. In this case, the scanner calculates and displays the convex hull of the figure, that is, the smallest convex figure containing the non-convex figure outlined by the user (see Fig. 2). The system bases the calculation of the ellipsoid volume on the convex hull.

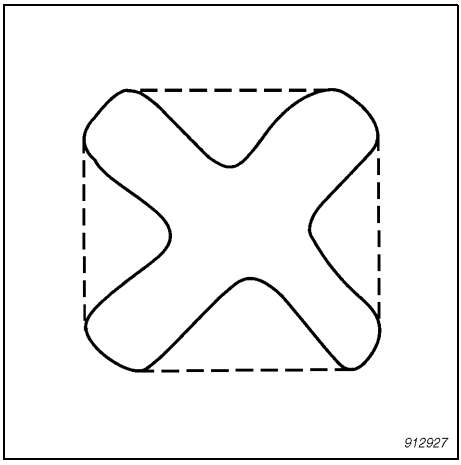


Fig. 2. The dotted line indicates the convex hull of the non-convex figure.

Measuring volume using a stepping method produces an approximation caused by the finite number of steps in the measurement. The user must always try to assess how large an inaccuracy is introduced by the selected step size, that is, the distance between organ cross sections.

Geometric Measurements

2D Measurements

The geometric measurements performed by B-K Medical ultrasound scanners are distance, perimeter, area and ellipsoid volume. The accuracy of these measurements is influenced by the following factors:

- transducer geometry
- rounding of results
- resolution of digital image memory

Time Measurements

In M mode, data is displayed along a time axis. It is possible to measure time differences. The accuracy for a time difference measurement is:

- rounded to the nearest: 0.01s
- accuracy: 0.01 x *t*
  where *t* is the full time scale of the image field.

References

[1] EN 60529:1991 + A1:2000. *Specification for degrees of protection provided by enclosures (IP code).*

[2] EN/IEC 60601-1:1990 +A1:1993+A2:1995+A13:1996 *Medical electrical equipment. Part 1: General requirements for safety.*

[3] EN 60601-2-37:2001 +A1:2005+A2:2005 *Medical electrical equipment – Part 2-37: Particular requirements for the safety of ultrasonic medical diagnostic and monitoring equipment.*

[4] UL 2601-1:2003 *Medical Electrical Equipment – Part 1. General Requirements for safety.*

[5] CSA C22.2 No. 601.1–M90:2001 *Medical Electrical Equipment – Part 1. General Requirements for safety.*

[6] EN 60601-1-2:2002 + A1:2006 *Medical electrical equipment - Part 1-2: General requirements for safety. Collateral standard: Electromagnetic Compatibility-Requirements and tests.*

[7] EN 60601–1–1:2001 *Medical electrical equipment – Part 1-1: General requirements for safety. Collateral standard: Safety requirements for medical electrical systems.*

[8] *Information for Manufacturers Seeking Marketing Clearance of Diagnostic Ultrasound Systems and Transducers.* FDA Center for Devices and Radiological Health. September 1997.

[9] *Acoustic Output Measurement Standard for Diagnostic Ultrasound Equipment.* AIUM/NEMA. 2004.

[10] *Standard for Real-Time Display of Thermal and Mechanical Acoustic Output Indices on Diagnostic Ultrasound Equipment.* AIUM/NEMA. 2004.

[11] *Medical Ultrasound Safety.* American Institute of Ultrasound in Medicine. 1994.

[12] ALARA Training Program. Ultrasound III Training. B-K Medical. 1993.

[13] Bioeffects considerations for the safety of diagnostic ultrasound. *Journal of Ultrasound in Medicine*, Vol. 7, No. 9 (supplement). September 1988.

[14] *The safety of diagnostic ultrasound.* The British Institute of Radiology. 1987.

AIUM: American Institute of Ultrasound in Medicine
EN: European Standards
CSA: Canadian Standards Association
IEC: International Electrotechnical Commission
NEC: National Electrical Code
NEMA: National Electrical Manufacturers Association
UL: Underwriters Laboratories Inc., USA

Section A

General Information

A.1 Getting Started 1

General Information 1
Turning the Scanner On and Off 1
Adjusting the Front Panel 1
Adjusting the Monitor Position 2
Docking the Flat Screen on Arm 2
Adjusting Monitor Brightness 3
Advanced Display Options 4
Some General Terms 6
F1 – F5 7
Screen Display 7
Connecting the Palm Control Unit 9
Connecting a Transducer 9
Selecting a Transducer 10
Selecting a Scanning Mode 11
Starting Scanning 11

A.2 Customizing Your System 11

Transducer Setup 12
System Setup 15
Imaging 15
Measure 16
Display 20
Basic Config 22
Copy Setup 23
Shortcut Setup 24
OB Setup 25

A

A.3 The Front Panel Controls 26

Front Panel and Keyboard Controls Guide 26
Trackball 26
Select 27
Delete 27
Pointer 27
Freeze 27
MFI 28
Zoom 28
Size 29
Copy 29
Split Screen 29
Simultaneous Split Screen Function 30
Puncture 31
Xmit Power 32
M-Line 32
Select Application 32
Distance 33
Label 33
Orientation 37
Bodymark 38
Other Front Panel Controls 42
Foot Switch 42

A.4 Palm Control Unit (PCU) 43

Mouse Stick 43
Selecting a Transducer 43
Select Application (Appl) 44
Puncture 44
Picture in Picture (PiP) 44
Orientation 44
Size 44
B-mode 44
B Gain 45
Freeze 45

Pointer 45
Distance 45
Color Box/Doppler Gate 45
Range 45
CFM/Power 45
Duplex/Triplex 45
Color Gain 46
Sterile Covers 46

A.5 The Keyboard 46

Patient Identification 46
Partial Reset and Full Reset 47

A

A.1 Getting Started

General Information

Before switching on the scanner, make sure that the installation has been approved by a qualified electrical engineer or hospital safety personnel. See “General Safety Precautions” in the introductory section of this user guide.

An optional Palm Control Unit (PCU) is available, allowing remote operation of the scanner. The PCU contains frequently used functions including those a surgeon or other clinician would need to use during scanning.

The front panel is shown at the front of this user guide. It may be helpful to refer to this whilst reading this section.

Turning the Scanner On and Off

To turn the scanner on and off, use the green power switch situated on the front of the scanner.

Caution:
Do not switch the scanner on and off repeatedly in quick succession. Doing so may damage the equipment.

If installed, the PCU should not be used, in particular the mouse stick should not be touched, for 12 seconds after the scanner has been turned on. This is to allow time for the PCU setup.

Adjusting the Front Panel

The height of the front panel can be adjusted by loosening the 2 black screws under the front panel, moving it up or down and tightening the screws afterwards.

The front panel can also be removed from the scanner to improve operator comfort.

To remove the front panel, tilt it upwards 90° and lift it out. It can be used up to 1 meter away from the scanner. There is an extension cable available (AO0421) which allows you to operate the scanner at a distance of up to 3 meters.

The space under the front panel can be used for storage, e.g. gel or paper etc.

Adjusting the Monitor Position

You can easily adjust the position of the monitor to make scanning comfortable for the operator.

To Adjust the Height of the Monitor:

1. Loosen the 2 black screws on the back of the monitor base.
2. Move the monitor base up or down.
3. Tighten the screws.

To Change the Viewing Angle of the Monitor:

- Use the handle on the front of the monitor to swivel it from side to side and tilt the screen up or down.

Fig. A1. Thumb screw for adjusting resistance on the back of the LCD flat screen monitor

To Adjust the Force Required to Change the Viewing Angle of the Flat Screen Monitor:

- Use the thumb screw on the back of the LCD flat screen to increase or decrease the monitor's sensitivity to angle adjustments.

Docking the Flat Screen on Arm

The flat screen monitor on the articulated arm can be docked. This prevents it from moving around, which is particularly important when the scanner is being moved to another location.

To Dock the LCD Flat Screen:

1. Standing in front of the scanner, maneuver the flat screen on the arm so that the front of the monitor is over the front of the scanner body.
2. Holding the monitor handle, guide the monitor back.
3. Still holding the handle, press so that the monitor clicks into place.

Caution:

Avoid using excessive force when docking the flat screen monitor.

Caution:

We recommend that you dock the flat screen monitor before you wheel it around the hospital.

Caution:

Do not put any weight on the arm nor use it as a lever. The arm is only designed to support the weight of the flat screen monitor.

Adjusting Monitor Brightness

Your scanner may be used with different levels of room lighting. Whenever the lighting changes significantly, you can adjust the monitor brightness using the buttons on the front of the monitor (Fig. A2).

Fig. A2. Flat screen monitor buttons

You can restore the factory default setting by pressing the **Auto** monitor button twice.

To Adjust the Screen Brightness on the Monitor:

1. Freeze the image in B-mode and press <Alt><Shift><G>. A series of test pictures appears. (You can use <Alt><Shift><G> to toggle between them - see Fig. A3).

Test picture	Description
Brightness	The test picture has two dark rectanges in the center, one is 2/255 and the other is 4/255 of 100% white.
Contrast	The test picture has a 100% white square in the center. **Note:** Adjusting the contrast can cause problems with the brightness range. Leave the contrast setting as it is.
Visual Check	The test picture displays a linear eight step grayscale for a final visual check of the monitor adjustments. Each step should be equal in size.
Test	Gray square. This is not used.
Test	Blank. This is not used.

Fig. A3. Test pictures on the monitor

2. When the brightness test picture is on the screen, press ☼/◀ once to enable the brightness control.
3. Press ◑/▶ to increase or press ☼/◀ to decrease brightness. Adjust the lighter square to be just visible.
4. Press **Menu** to close the brightness control menu.
5. Toggle to the Visual Check test picture. The picture should show an even progression of gray scales.
6. When you have adjusted the brightness, unfreeze the image to remove the test pictures from the screen.

Advanced Display Options

On the flat screen monitor, advanced options (which enable you to finely tune the appearance of images on the screen) are available via the Menu window.

Most users do not need to adjust these settings because the default settings provide the optimal ultrasound image in most cases. However, should it be necessary, gamma settings and aspect-ratio controls are available and can be adjusted.

Gamma settings (gray scales)

Three gamma settings are available:

- B-K gamma 1 – factory default setting recommended by B-K Medical.
- B-K gamma 2 – the usual gamma setting for the flat screen.
- B-K gamma 3 – a third gamma setting.

Aspect ratio

The aspect ratio of an image on the screen is the ratio of its width to its height. Thus an image with an aspect ratio of 2:1 is twice as wide as it is high. Three aspect ratios are available:

- 4:3 Full – default setting. The original image produced by the scanner is scaled up to fit the screen best, to give a larger image.
- 4:3 Native – image has same shape, but fills only 800x600 pixels. The image is smaller than the default, but it may appear sharper.
- 5:4 Full – normal PC setting for an image to fill the entire screen, height as well as width. This is not used for scanner displays.

To Access the Menu Options:

1. Press **Menu** (see Fig. A2) and hold it down for 10 seconds. The Menu window appears. The Menu window automatically disappears within 20 seconds if you do not press another button.
2. Use ◑/▶ to scroll across through the menu options. The active option appears yellow.
3. Press **Menu** to select the desired option and to display the settings available. The active setting appears yellow.
4. Use ◑/▶ to scroll through the settings, and press [Menu] to select the desired setting.
5. Press **Auto** to return to the menu, scroll to **Exit** and select it to close the Menu window.

Note: To save your settings, you must close the Menu window by selecting **Exit**. If the menu times out, the display will revert to the previous settings when you restart the scanner or turn the display off and on.

Some General Terms

The following general terms are used to explain the use of the scanner:

Soft Menus or Menus

These are menus that appear above or below the monitor display. They are easily recognizable by the vertical dividing lines that distinguish the available menu options. The menu options are used in combination with the **F1** to **F5** controls on the front panel and the ↶ key. The **F1** to **F5** controls correspond to the menu options in a logical way, i.e. the **F1** key selects the left-most menu option, and so on. The ↶ key returns you to the previous menu or screen display.

Setup Pages

These appear on the main screen. They are used to either enter data, or to select parameters from a number of displayed options.

Keys, Buttons and Controls

These terms are all used to refer to the use of the front panel and if installed, the Palm Control Unit (PCU), for example "use the **Select** ☞ control". In some cases **Soft keys** are described. These are the options that are part of the Soft Menus and are accessed using the **F1- F5** controls on the front panel. The term mouse stick refers to the knob on the PCU which is used for positioning and pointing, its function is the same as the trackball on the front panel.

Moving Around and Selecting Options

Options are selected in several ways using the control panel, keyboard, and if installed, using a Palm Control Unit (PCU). In this manual controls are highlighted in bold, for example, the **Freeze** ✱ control. Keyboard keys are identified using angle brackets, for example, press<Alt> <B >. Where <Alt> is stated, the <Alt> key should be held down while pressing an associated key.

Moving around the different menus can be done in several ways. Pressing the ↶ control will take you back to the previous menu. You can also press any other control to leave a menu. For example, if you are currently in the Measure menu and you want to go to the Puncture menu, press the ⁘ control.

F1 – F5

The controls **F1** through **F5** are used to access soft keys. These are menu options that appear on the monitor.

For example, when you press the **Basic** control (**Q** on the keyboard), the menu shown in Fig. A4 appears on the monitor. You can access the menu options by pressing their corresponding **F** controls on the front panel. That is, to select the Draw option from the Basic measure menu (Fig. A4), press **F3**.

HWL		Draw		
F1	F2	F3	F4	F5

Fig. A4. An example of a soft menu, in this case the Basic measure menu

The currently activated soft key is highlighted.

Screen Display

General Data

The following data is displayed on the screen at all times; date, time, hospital ID, patient ID, transducer type number, frequency and record/freeze.

Image Data

The image data displayed on the screen for the different scanning modes is listed in Fig. A5.

Image line	B	B+M
1	B Gain	B Gain
2	FR	FR
3	MI	TI
4	Persist	Persist
5		M Gain

Key: FR = Frame Rate MI = Mechanical Index TI = Thermal Index

Fig. A5. Image data displayed on the screen in different modes

Measure line	Basic	Basic HWL	Uro-HWL	Uro-pln	Uro-Aut	Uro-Emp
Measure 1	HR		Organ	Organ	Organ	Organ
Measure 2	Dist1	Height	Height	Number	Area1	Area1
Measure 3	Dist2	Width	Width	Step	Area2	Area2
Measure 4	Dist3	Length	Length	Area	Volume	Volume
Measure 5	Dist4	Factor	Volume	Volume		
Measure 6	Angle 1,2	Volume				
Measure 7	MeanDia					
Measure 8	Perimeter					
Measure 9	Area					
Measure 10	Volume					

Fig. A6. Basic and urology measurements screen display

During measuring, the data shown in Fig. A6 and Fig. A7 can be displayed on the screen.

Measure line	M-Calc LV	M-Calc MV	M-Calc Ao	Cardiac	OB-Calc
Measure 1	HR	HR	HR	HR	LMP/GAc
Measure 2	ET	ET	ET	EdL	GAu
Measure 3	IDd/IDs	CEamp	RVOD	EdA	FW
Measure 4	EdV/EsV	DEamp	AVD	EsL	Meas1
Measure 5	SV	CAamp	LAD	EsA	Meas2
Measure 6	CO	DEslp	AOD	EdV	Meas3
Measure 7	EF	EFslp	LAR	EsV	Meas4
Measure 8	FS	CA/CE		SV	Meas5
Measure 9				CO	Meas6
Measure 10				EF	Meas7

HR = Heart rate, ET = Ejection time, EdL = End diastolic long axis, EdA = End diastolic area, EsL = End systolic long axis EsA = End systolic area, EsV = End systolic volume, SV = stroke volume, CO = cardiac output, EF = Ejection fraction, BSA = Body surface area, SI = Stroke volume index, CI = Cardiac output index, IDd = Interventricular dimension at end diastole, IDd = Interventricular dimension at end systole, EdV = End diastolic volume, amp = amplitude, slp = slope, RVOD = right ventricular outflow tract diameter, AVD = Aortic root diameter, LAD = left atrium diameter, AOD = Aortic valve diameter, LAR = LAD/LAR ratio, LMP = Last menstrual period, GA = Gestational age

Fig. A7. Measurements and calculation results displayed on the screen for cardiac, M-calc and obstetric scanning

Connecting the Palm Control Unit

The Palm Control Unit (PCU) is connected to an adaptor (UA1271) and attached to the RS232 B socket on the rear panel of the scanner. See Section H.13 “Connecting a Palm Control Unit” for further details.

It should be noted that the PCU should not be used, in particular the mouse stick should not be touched, for 12 seconds after the scanner has been turned on. This is to allow time for the PCU setup.

Connecting a Transducer

There are three sockets available for transducers. Two are for connecting transducers to the scanner and one is for transducer parking. See Fig. A8.

There is an extra socket marked for single-element transducers. This is an optional extra.

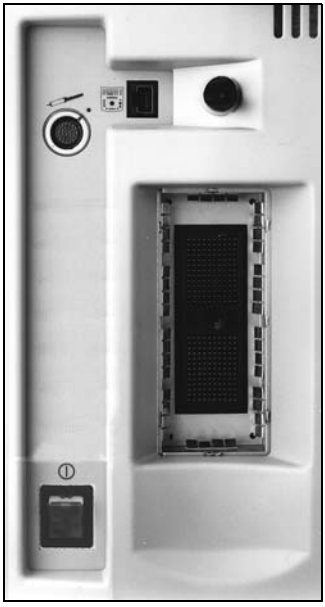


Fig. A8. Front of the scanner showing one of the array transducer sockets and the single element transducer socket

After connecting the array transducer to the input socket, turn the locking-lever on the transducer's plug clockwise.

Transducer holders are built in to the front panel of the scanner, allowing convenient and secure placement for up to four transducers. Transducer holder inlays (DZ 9756) are available for use with the smaller transducers in the B-K Medical range (see "Accessories Available" in the Product Data sheet (BP0127) that accompanies this user guide).

Selecting a Transducer

For information on the B-K Medical range of transducers, contact your local B-K Medical sales representative.

A maximum of two electronic and one mechanical transducer can be connected to the scanner at the same time. Press the control on the front panel or if installed, on the Palm Control Unit to toggle between the connected transducers.

When the scanner is initially powered up, it will check for connected transducers and select the first one. If there are no connected transducers, the **Freeze** control will be inactive.

The first time a transducer is selected, the default setup for that transducer is selected. Otherwise the last used setup is selected.

Pressing the transducers built-in control button will both select the transducer and start scanning.

Type 1850

If the 1850 is selected, the soft menu shown in Fig. A9 is displayed on the monitor. Press the appropriate **F** control to select a transducer head for the 1850.

8539	6004	6005		
F1	F2	F3	F4	F5

Fig. A9. The menu for Type 1850

Type 2050

If the 2050 is selected, the soft menu shown in Fig. A10 is displayed on the screen. Press the appropriate **F** control or **C** on the

keyboard (the factory default setup shortcut key) to select the crystal for the 2050.

2050 12MHz	2050 16MHz			
F1	F2	F3	F4	F5

Fig. A10.The menu for Type 2050

Selecting a Scanning Mode

The 2101 EXL Premium can scan in the following modes and combinations: B, and B+M (M-mode). Press the **B/M** control on the front panel to toggle between the two modes.

Starting Scanning

There are two ways to start scanning. If the transducer has a built-in control button, press this control. Alternatively, press the ⊛ control on the front panel or if installed, on the Palm Control Unit (PCU).

A.2 Customizing Your System

This section describes how you can customize the system to fit your individual needs. The system setup pages, shortcut options and transducer application setups have been designed to help you tailor the system for easy usage.

Press **Setup** on the keyboard to display the Setup menu (Fig. A11). This menu is used to access Setup pages. These pages allow multiple parameters to be set.

To use a Setup page, use the trackball or the mouse stick on the PCU to select fields. An example section of Setup page containing fields is shown in Fig. A12. These fields contain three types of parameter as follows.

Parameters marked with a ☑ or a ☐ checkbox are pre-defined entries that can be toggled on and off with the ☞ control.

Parameters marked with a ☐ checkbox offer a number of possible selections. Use the ☞ control to step through these.

Parameters marked with a ☐ checkbox are user-defined text. Use the keyboard to enter text. A user-defined text entry is completed by pressing ↵ on the keyboard. The cursor will move on to the next menu field.

Transd. Setup	System Setup	Shortcut Setup		OB Setup
F1	F2	F3	F4	F5

Fig. A11.The Setup menu

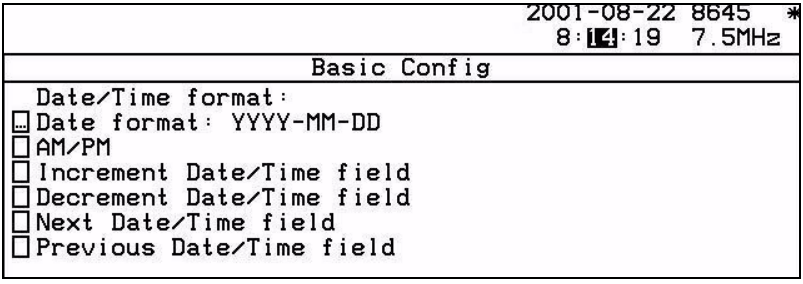


Fig. A12. Example section of a Setup page

Transducer Setup

This function enables you to save your current transducer settings as an application setup for the selected transducer. Alternatively you can reset an application setup to the original factory setting. Four application setups can be stored for each transducer.

Press **Transd. Setup** (**F1**) on the Setup menu (Fig. A11) to display the first Transducer Setup page (Fig. A13) and the Transducer Setup menu (Fig. A14).

If using a Shock Wave Device system, refer to the appropriate manufacturer's user guide.

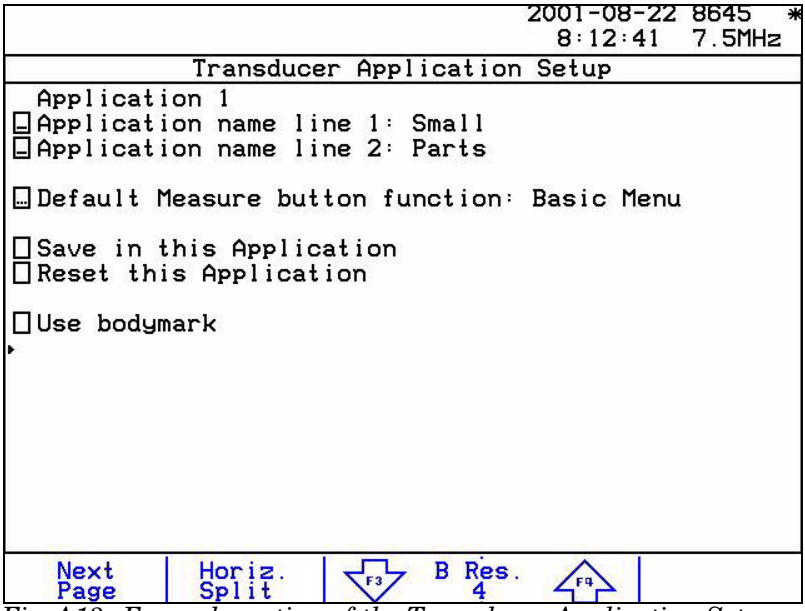


Fig. A13. Example section of the Transducer Application Setup page 1.

Next Page	Horiz Split	B Res 3		
F1	F2	F3	F4	F5

Fig. A14. Transducer Setup menu

To save the current settings as an application setup for the selected transducer, activate the appropriate **Save in this application** field on the Transducer Application Setup page (Fig. A13).

To reset the application setup to the factory setup for the selected transducer, move the trackball to the appropriate **Reset this application** field on the Transducer Application Setup page and press the ☞ control.

Press **Next page (F1)** to go to the next page of transducer application setups. There are 4 possible transducer setups, one on each setup page.

Horizontal Split

This function enables you to choose a horizontal split screen instead of a vertical split screen (as described in Section A.3).

Press **Horiz. Split (F2)** to toggle the horizontal split screen function on and off. The setting is stored with the application setup when this is saved and will take effect the next time that the split screen is activated.

B Res

This function allows you to optimize the resolution for the selected transducer. Use **F3** and **F4** to adjust the resolution between 1 and 3.

Change Application Setup Name

The application setup name can be changed by moving the trackball to the appropriate name field on the Transducer Application Setup page (Fig. A13) and pressing the ☞ control. The name is split into two lines of 9 characters each. Your chosen application names will appear in the Transducer Setup pages and the Select Application menu (Fig. A27).

Default Calculator Button Function

The function of the **Calculator** button can be selected by the user. Fig. A15 shows the possible settings for this control.

Setting	Function
Basic Meas	Mirrors the **Basic Calc** control
Basic HWL	Mirrors the **Basic HWL** control
Ob	Mirrors the **OB Calc** control
Cardiac	Mirrors the **Car Calc** control
Urology Calc	Mirrors the **Uro Calc** control
Urology HWL	Mirrors the **Uro HWL** control
Urology PLN	Mirrors the **Uro PLN** control

Fig. A15. Possible default settings for the control

Use the trackball to go to the Calculator Button Function field and press the ☞ control to toggle between the different settings.

Use Bodymark

To set the default bodymark associated with the transducer set-up, move the trackball to the appropriate field on the Transducer Application Setup page (Fig. A13) and press the ☞ control. The Bodymark page is displayed (see later in this Chapter, Fig. A33). Select the required bodymark and this will then be associated with this transducer application setup after you have saved it in the setup.

System Setup

This function enables you to change some system parameters. Press **System Setup** (**F2**) on the Setup menu (Fig. A11) to display the first System Setup page shown in Fig. A16.

Imaging

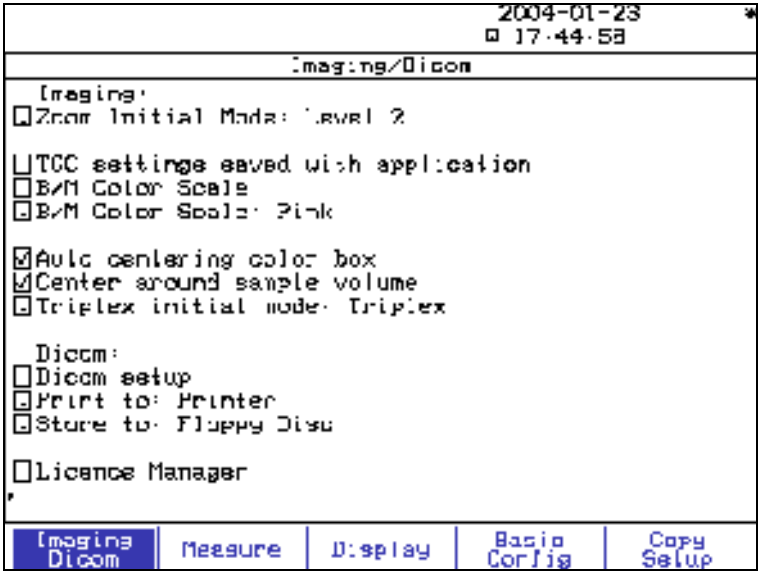


Fig. A16. System Setup - Imaging

Zoom Initial Mode

Using this function you can select the Zoom Initial Mode. This means that you can define the default setting for the **Zoom** control. You can choose zoom levels 1, 2, 3 or panning. The differ-

ent levels refer to the size of the zoom box. The factory default level is 2.

Use the trackball to select the Zoom Initial Mode field and then use the ☞ control to toggle between the different options.

TGC Settings Saved with Application

This function allows you to save the TGC (Time Gain Compensation) settings with transducer application data. Use the trackball to go to the TGC settings saved with application field and use the ☞ control to toggle this function on and off.

DICOM

Note: DICOM is not available with the scanner.

Measure

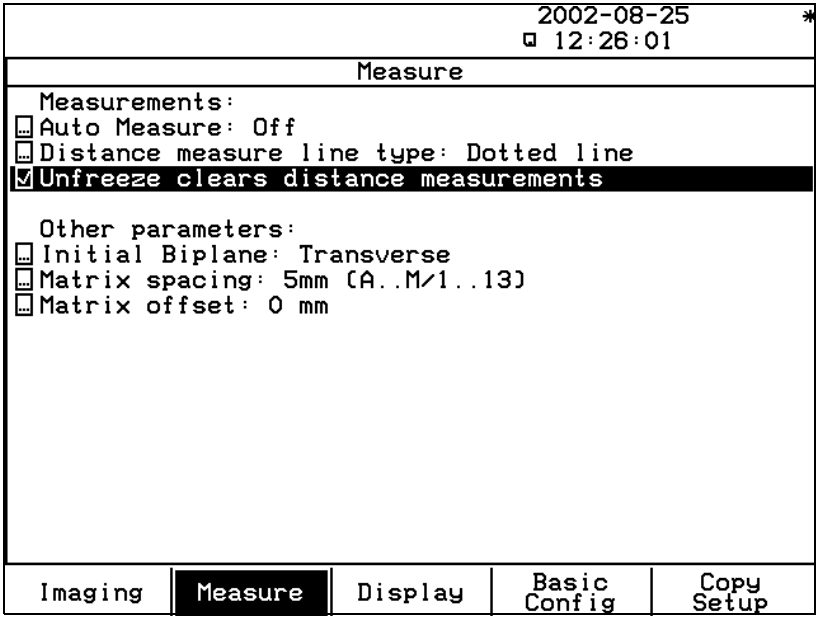


Fig. A17. System Setup - Measure

Auto Measure

The **Auto Measure** function allows you to activate the Calculator or distance function as soon as scanning stops. The function of the **Calculator** button is dependent on which setting has been cho-

sen. Use the trackball to go to the Auto measure field and press the ☞ control to toggle this function between:

Setting	Function
Off	Auto Calculator and Auto dist turned off
Measure	Default Calculator function
Active measure	Current calculator function re-enabled when scanner is frozen. (Basic, basic HWL, Uro, OB, Car, Urology HWL, Urology PLN or Vasc
Distance	Distance function enabled when scanner frozen

Fig. A18. Auto Measure field settings

Distance Measure Line Type

This function is used to set up how the distance line between two measured points will appear on the screen. Use the trackball to select the Distance Line Pattern field, and then use the ☞ control to toggle between no line or dotted line.

Unfreeze Clears Distance Measurements

This function enables you to display or remove distance measurements when scanning.

Use the trackball to select Unfreeze clears distance measurements and ☞ to check this function on or off.

This function is checked on as the default setting.

Initial Biplane

Using this function you can select the initial scanning plane for the Type 8808 Biplane transducer.

Use the trackball to select the Initial Biplane field and then use the ☞ control to toggle between sagittal and transverse planes.

Matrix Spacing

When the 8658 Biplane Transducer is used and you press the **Puncture** control, the menu in Fig. A19 will be shown on the monitor. When you then press **F5**, the BRACHY seed matrix template selected using this Matrix spacing function will be displayed on the monitor.

	UA1232	BRACHY 5mm	BRACHY 10mm	BRACHY PROG.
F1	F2	F3	F4	F5

Fig. A19. The Puncture soft menu for an 8658 Transducer

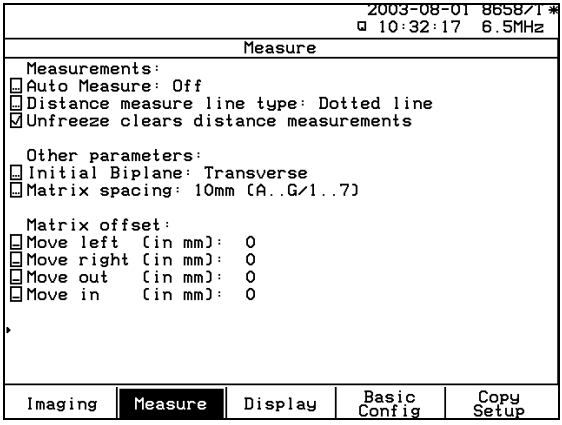
Use the ☞ control to select the seed matrix spacing and coordinates. You can toggle through the following options:

- 5mm (A..G/1..7) - also selected using **F3** as shown in Fig. A19.
- 10mm (A..G/1..7) - also selected using **F4** as shown in Fig. A19.
- 5mm (A..M/1..13)
- 10mm (A..M/1..13)

Caution

Ensure that the coordinates specified agree with the actual matrix template.

Matrix Offset



As with the Matrix spacing (above), you can change the matrix offset in 1.0mm steps from –10mm to +10mm, right/left and in/out. The default setting is 0mm, which is used to align a non-standard matrix.

Caution

Prior to seed implantation using the needle guide matrix, the matrix offset value should be checked to make sure it corresponds with the chosen matrix. The matrix alignment should then be checked. To do this, refer to the next Section "Checking the Alignment of the Matrix".

Checking the Alignment of the Matrix

B-K Medical recommends that the alignment of the matrix is checked once a month (or more frequently if a misalignment is suspected).

Note: The best accuracy that can be expected is 3mm deviation.

To check the alignment of the matrix:

1. Fill a suitable tank with saline. The concentration of the saline depends on the room temperature. It should be 4% NaCl at 25°C and 5% NaCl at 20°C.
2. Assemble the matrix and, with a transducer mounted, connect the plug of the transducer to the scanner.
3. Immerse the transducer tip in the saline.
4. Start scanning to present an image on the monitor.
5. Superimpose the relevant puncture matrix template on the monitor.
6. Insert a needle through the matrix and measure the deviation from the point shown on the monitor.
7. Decide whether the accuracy is acceptable.
8. If the accuracy is not acceptable, contact your local B-K Medical service center.

A

Display

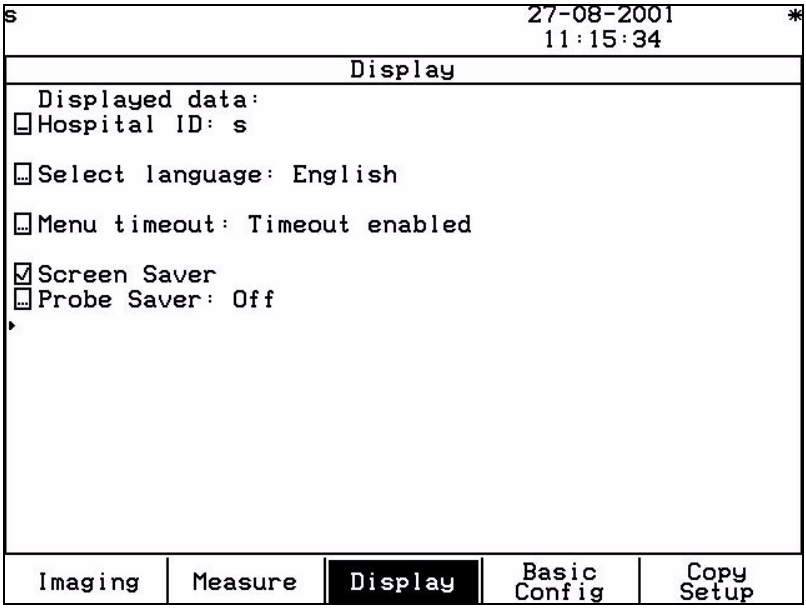


Fig. A20. System Setup - Display

Hospital ID

To enter a hospital identification:

1. Use the trackball to go to the Hospital ID field.
2. Use the keyboard to type in the hospital identification.
3. Press ↵ (Enter) to accept the new hospital identification. The cursor moves on to the next field.

Select Language

You can choose the language of the text that appears on the monitor. The languages available are English, French, German, Italian, Spanish, Swedish, Finnish, Portuguese, Russian, Danish and Dutch. If the languages cannot be selected, check the Configuration Switch 1 at the back of the scanner. The setting is: Left = language selectable (Default); Right = English only. See Section H.12 “Configuration Switch” for details. With Switch 1 in the leftmost position, you can use the trackball to select the Language field. Then use the ☞ control to toggle between the available languages.

The selected language will become operational after switching off and then re-booting the scanner.

Menu Timeout

This function will determine how long the soft menus remain on the screen. Use the trackball to go to the Menu Timeout field and press the ☞ control to toggle between Timeout Enabled or Disabled. When the timeout is enabled, the soft menu will disappear from the screen after approximately 8 seconds. In the Timeout Disabled state, the menus are not removed until a new function is activated, a new menu appears or the image is not frozen.

Screen Saver

The **Screen Saver** control enables you to activate the screen saver function. When this function is on, a screen saver appears on the monitor when the scanner has not been used for 7 minutes. The scanner will come out of screen saver when a key or the trackball is used. Use the trackball to go to the Screen Saver field and press the ☞ control to toggle the function on and off.

Probe Saver

The **Probe Saver** control enables you to activate the probe saver function. When this function is on, the image is frozen when the scanner has been recording images for a defined length of time with no user input. A message is displayed on the screen indicating that the probe saver has frozen the scanner.

Use the trackball to go to the Probe Saver field and press the ☞ control to toggle between Off, 10, 20 or 30 minutes. The factory default setting is Off.

Caution

If at any time the scanner malfunctions or you suspect that the scanner is not functioning correctly, then you should always as a precaution remove transducers from contact with the patient.

Basic Config

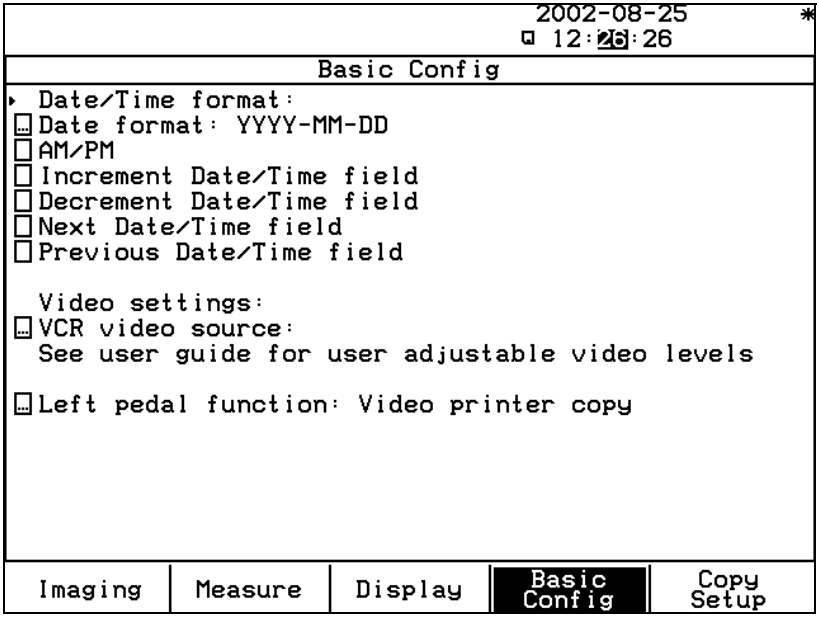


Fig. A21. System Setup - Basic Config

Date Format

To select the date format use the trackball to go to the Date Format field and press the ☞ control to toggle between the different date formats: YYYY-MM-DD, MM-DD-YYYY or DD-MM-YYYY.

AM/PM

Use the trackball to go to the AM/PM field and press the ☞ control to toggle between the 12 hour or 24 hour clock display options. When the box is ticked, the 12 hour display option is activated.

Date/Time

Use the trackball to go to the Increment Date/Time and Decrement Date/Time fields. The Date/Time part of the clock display is automatically highlighted. Press the ☞ control to adjust date and time parameters.

To select the appropriate date/time field use the trackball to go to the Next/Previous, Date/Time fields and press the ☞ control to step through the date and time parameters. Return to the Increment/Decrement Date/Time fields to adjust the value.

Video Settings

The **VCR video source** field enables you to select the source of the VCR video image, displayed when you press the VCR control (<V> on the keyboard). The options are; Composite, S-VHS, or RGBS. Note also that no measurements are active when in VCR mode.

Picture Settings - Brightness, Contrast and Saturation

These parameters can be adjusted when the following video images are displayed:

- VCR image or full-screen video image when the source is S-VHS or Composite (not RGBS).

The picture is adjusted as follows:

To adjust the contrast up or down use the keyboard up and down arrows. Press <Shift><Alt> <⇧> or <⇩> respectively.

To adjust the brightness up or down, press <Shift> <⇧> or <⇩> respectively.

To adjust the color saturation up or down, use the keyboard right and left arrow keys. Press <Shift> <⇨> or <Shift> <⇦> respectively.

To reset the color, brightness and contrast, press <Shift><Alt><V>.

Left Pedal Function

You can choose the function of the left pedal of the foot switch. The foot switch is described later in this chapter. Fig. A37 shows a table with the available functions for the left pedal.

Use the trackball to select the Left Pedal field, and then use the ☞ control to toggle through the available functions.

Copy Setup

This function cannot be used with this scanner.

A

Shortcut Setup

Using this function, you can define a set of shortcut keys to simplify the selection of measurement parameters in the Urology and Obstetrics packages and to simplify selecting a scanning mode. There are 2 shortcut setup pages, one for the OB package, and one for urology and other parameters.

Press **Shortcut Setup (F3)** on the Setup Menu (Fig. A11) to display the shortcut keys setup page for OB parameters, as shown in Fig. A22. A Shortcut setup menu is also displayed. This contains a **Next Page** option (**F1**). Press (**F1**) to go the Urology and other parameters Shortcut page as shown in Fig. A22.

To add, or change a shortcut key, use the trackball to select the parameter and then the keyboard to enter a new shortcut character. If another parameter has already been assigned to your chosen key, the system will replace this with the new character.

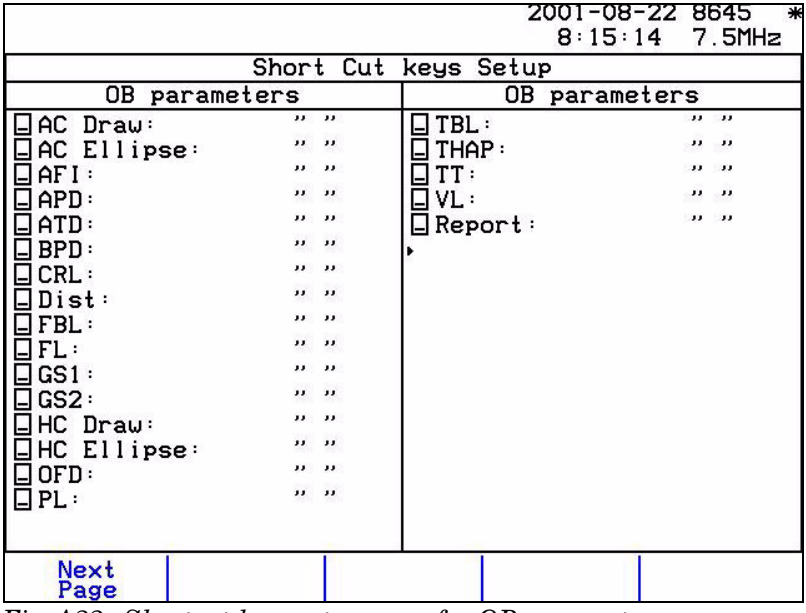


Fig. A22. Shortcut keys setup page for OB parameters

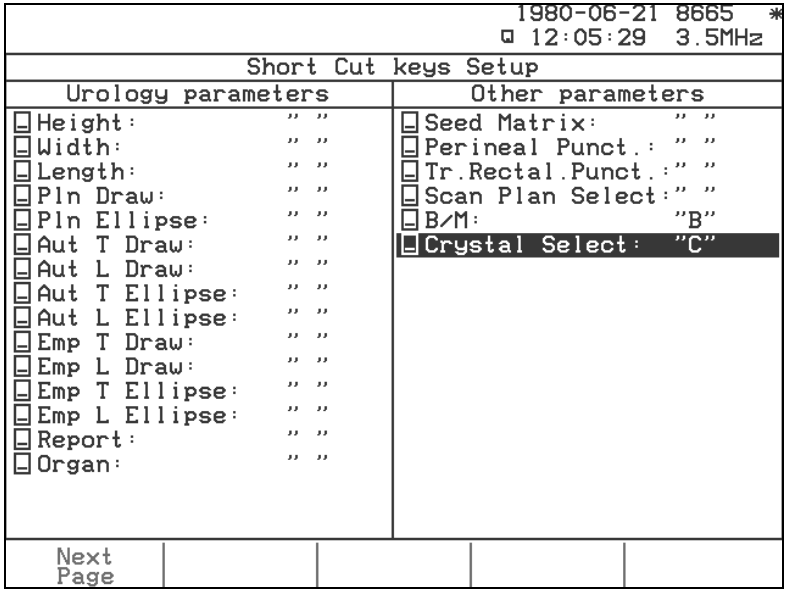


Fig. A23. Urology and other parameters shortcut keys setup page

The five sections of the space bar (divided by vertical lines) may also be used as five different shortcut keys. You cannot use a keyboard key that has been system-predefined for another purpose.

To help you remember the shortcut keys you have set up for the OB package, a set of stickers is available. The set (SC1474) contains stickers for each of the parameters for which a shortcut is available. You may stick these on the keys on your keyboard (see "Accessories Available" in the Product Data sheet (BP0127) that accompanies this user guide).

A list of predefined keyboard shortcuts can be found in Appendix 1.

OB Setup

For instructions on defining your OB Setup, see Section E.3 "OB Setup".

A

A.3 The Front Panel Controls

Front Panel and Keyboard Controls Guide

The icons on the front panel and the keyboard functions are listed on the Keyboard Control Guide (SC1452) that is included with the scanner. You may find this useful to refer to whilst using the scanner. This card can be stored in the storage compartment under the front panel or on the scanner's shelf.

Trackball

The trackball is used for drawing and positioning.

Trackball Adjustment

The trackball should move smoothly. If it is too tight or too loose you can adjust it using the adjustment tool (QA0228) (See Fig. A24).

Fig. A24. Trackball adjustment tool

To adjust the movement of the trackball, place both ends of the tool into the small holes in the black ring of the trackball housing. Turn clockwise to tighten and counterclockwise to loosen the trackball. The trackball can be removed completely for cleaning.

Select ☞

The ☞ control is used for selecting markers during measurements, for zooming-in on a selected area when the zoom function is active, for updating zoom, and for selecting a label on the monitor display. It is also used to select or toggle through different options on setup pages.

Delete ✕

The ✕ control is used to clear distance measurements and labels, and to erase backwards when drawing a perimeter.

Drawings are deleted when the screen content changes, e.g. turning a report on/off, changing the mode or going from freeze to record.

Pointer ⇖

This function gives you the possibility of placing up to two arrows on the monitor which can be used as pointers. Four pointing directions are available for the arrows.

To display the pointer, press ⇖ on the control panel. The trackball can then be used to move the arrow to the required location. Use the ☞ control to toggle between the four possible pointing directions.

Press ⇖ a second time to display the second arrow on the screen. When two arrows are displayed, press ☞ to toggle between the two arrows. The ✕ control can be used to delete the active arrow.

If the trackball has been used for other purposes, use the ⇖ button to gain control of the arrow.

The arrows are deleted when scanning starts, or when the ⇖ button is pressed for more than one second.

Freeze ⊛

The ⊛ control lets you start and stop scanning. When a transducer has been connected, press ⊛ to start scanning. To stop scanning ("freeze" the image), press ⊛ again. If the transducer in use has a built-in control button, press this button for less than 1 second to start and stop scanning.

MFI

If an MFI (Multifrequency Imaging) transducer is selected, press the **MFI** control to step through the frequency options. The selected frequency is then displayed at the top of the screen.

Zoom

This function is used to zoom into a specific area of the ultrasound image. A maximum of 7 zoom levels are available, but this is transducer-dependent and size-dependent. Subject to certain limitations, the zoom frame may be freely positioned in the ultrasound image.

You may use zoom in two ways, either by selecting the zoom area or by panning. In zoom panning you can move and resize the zoomed area without zooming out of the image.

The zoom function is activated by pressing the control on the front panel. The function will either start up at a specified zoom level or panning, depending on which option has been chosen in the system setup. (See Section A.2 “Customizing Your System”)

Zoom Area Selection

1. Press the control. A frame appears on the monitor display.
2. Use the trackball to move the frame to the desired area.
3. Press the up/down control to adjust the size of the zoom frame.
4. After a few seconds, the scanner will automatically zoom in on the selected area when you have finished resizing and moving the frame. Pressing the control or the control will also zoom in on the selected area.

Zoom area panning will also be activated if no input has been received by the trackball or other keys within a time-out period.

Zoom Area Panning

1. Press the control. A frame appears on the monitor display.
2. Use the trackball to move the frame to the desired area.
3. After a few seconds, the scanner will automatically zoom in on the selected area when you have finished moving the

frame. Pressing the control or the control will also zoom in on the selected area.

4. The zoom area can then be moved using the trackball or sized using the up/down control.

To turn off the zoom function, press for more than 1 second.

Size

Press the up/down control to adjust the area of the tissue that the B-mode image represents. The image will always include the transducer surface and be centered around the mid axis of the transducer.

Copy

The control lets you make a hard copy of the monitor display on a connected documentation device.

Press to print to the video printer. If the transducer in use has a built-in control button, you can also activate **Copy** by pressing the built-in control button for more than 1 second. If the scanner is in record mode, the image will be frozen while the video printer is triggered.

Split Screen

This function lets you display two different images on the monitor at the same time. Only one of the images is active at a time. The inactive image will not respond to changes in control settings or be updated while scanning. The screen can either be side by side i.e. split vertically, or one on top of the other, i.e. split horizontally.

The selection of horizontal or vertical split screen is determined in the transducer application setup and can be changed. See the Transducer Setup Menu on Fig. A14

When in Split Screen, you can scan in B-mode. If you select B+M -mode, the Split Screen facility will be switched off.

To activate Split Screen:

1. Press the ▢▢ control. The left or upper image will be active.
2. Press the ▢▢ control again to toggle between the left and right image (upper and lower image in horizontal split).
3. To return to a single image, press the ▢▢ control for more than one second.

Simultaneous Split Screen Function

This section only applies when using the Biplane Transducer Type 8808. This transducer can transmit transverse (T) and sagittal(S) images simultaneously.

Press the **Sim** control (<N> on the keyboard) for more than one second to return to a single image.

The transducer's two built-in control buttons are used to freeze and unfreeze the T and S planes.

In single-plane scanning (not in split screen) you can scan in either the T or S planes in all available modes. You can switch between S and T scanning by pressing the S and T buttons on the transducer.

With the split screen function activated, you can display the S and T plane images at the same time. Only one image will be active. Press the ▢▢ control to toggle between the S and T images being active.

For simultaneous scanning in T and S planes, press the **Sim** control (<N> on the keyboard). Both split screen images will be active. You can freeze the S or T images by pressing the S or T button on the transducer.

Pressing the ▢▢ control for more than one second in split screen will allow you to toggle between simultaneous biplane and full screen or between split screen and full screen.

Puncture

To superimpose a puncture line onto an ultrasound image:

1. Press the control to activate the default puncture guide for the selected transducer, if applicable.
2. If alternative puncture guides are available for a transducer, a Puncture menu is shown on the monitor. For example, Fig. A25 shows the menu obtained when an 8658 transducer is used. Press the corresponding **F** key to select a puncture guide. Press **BRACHY PROG.** (**F5**) to select the puncture guide selected in the "Measure" system setup in Section A.2 "Customizing Your System".

	UA1232	BRACHY 5mm	BRACHY 10mm	BRACHY PROG.
F1	F2	F3	F4	F5

Fig. A25. An example of a Puncture soft menu

3. To remove the puncture guide, press for more than 1 second.

Keyboard Shortcuts

A keyboard shortcut setup for superimposing a perineal puncture line and a seed matrix on the image. See Customizing Your System earlier in this chapter.

Ruler with Transducer 8658

A ruler view, which accomodates needle insertion, is available during brachytherapy with transducer Type 8658. The ruler consists of a set of vertical dotted lines extending across the width of the image display. The lines, which are 5mm apart, provide for tissue depth recognition. The dots in each line are spaced 2.5mm apart and allow you to guide the needle along a horizontal line for correct seed placement. The zero point of reference is adjusted as you move the probe.

With the scanner in 2D mode and the transducer placed in the sagittal plane, press your user-defined shortcut key to activate the ruler. Press the key again to turn the ruler off. See Section A.2 "Customizing Your System" for information on how to set up a shortcut key.

Xmit Power

This function is used to select and adjust the Thermal Index Limit (TI). Press the control to display the Tissue Type menu shown in Fig. A26.

Tissue Type	TI Limit ⇩ ⇧			
F1	F2	F3	F4	F5

Fig. A26. The Tissue Type menu

Use the **Tissue Type** soft key (**F1**) to toggle between the 3 tissue types; soft tissue (TIS), bone (TIB) and cranial tissue (TIC).

Use the **TI Limit** softkeys (**F2** and **F3**) to adjust the limit downwards and upwards.

M-Line

In B+M-mode the M-line on the image can be moved to choose the direction of scanning in M-mode. Press the **M-Line** control on the front panel and then use the trackball to move the line to the required position.

Select Application

Press the **Appl** control on the front panel to select one of your user defined transducer setups. The menu shown in Fig. A27 is displayed.

Application 1	Application 2	Application 3	Application 4	
F1	F2	F3	F4	F5

Fig. A27. Select Application menu

The application names that you have defined in Transducer Setup will appear in this menu (See Section A.2 “Customizing Your System”). Select the soft key for the application setup you wish to use. The active application is highlighted.

Distance

Pressing the distance control on the front panel will place a set of distance markers on the monitor one of which can be moved using the trackball. Pressing the control again will give extra sets of markers. For full details on how to make measurements, see Section B.3 “Making a Measurement”.

Label

This function allows you to place a label or comment on the ultrasound image. You may customize your label libraries to fit your individual needs or use the predefined factory setup.

There are three ways of placing a label on the screen: it can be entered using the keyboard; a predefined label can be selected from one of the five label libraries; or one of the two fast-labels can be used.

Fast-labels are user definable labels which can be accessed directly from the control. The predefined fast-labels are “right” and “left”.

To activate the label function, press the control on the front panel.

The initial function of the **Label** control can be user defined. You can choose between “label library” or “free text”. When the function is set to “label library”, pressing the control will access the label library. When set to “free text” pressing the control will allow you to enter “free text”. Instructions for setting the function of this control (**Label Setup**) can be found later in this section.

If there are no labels already displayed on the screen and the initial label function is set to “free text”, a rectangular cursor will appear on the screen.

Label text can be entered using the keyboard and moved using the trackball.

Press again to select the first predefined fast-label, and again to select the second predefined fast-label. The control can be used to toggle between the first fast-label, the second fast-label and no fast-label. You can continue to add a label or add text to a fast label. The fast-label text will always appear in front of the text that is already on the screen.

Note: A fast-label will not be inserted if the text will coincide with the screen border.

When the ABC control is pressed, either the Label Main menu (Fig. A28) or the Label Library menu (Fig. A29) is displayed on the monitor, depending on your setup.

Label Library		Save Position		Add Label
F1	F2	F3	F4	F5

Fig. A28. Label Main menu.

If there are labels on the screen when the ABC function is activated, one of the labels will be selected and will be ready to be edited and moved.

You can now take any of the actions described below.

To move, edit or delete a label which is on the monitor display:

1. Use the ☞ control to select the label to be entered. (Pressing the ☞ control toggles through the labels on the monitor.)
2. Move the selected label with the trackball.
3. To edit the selected label, use the keyboard.
4. To delete the selected label, press the ✕ control.

To change the default label position:

Move a label to the desired position and press **Save Position** (**F3**). Subsequent labels will start from the defined position.

To add a comment to the monitor:

1. Press the **Add Label** soft key (**F5**) on the Label main menu (Fig. A28).
2. Use the keyboard to type the text.
3. Use the trackball to position it on the monitor.

To select and place a label from a library:

1. Press the **Label Library** soft key (**F1**) to select the last used label library.
2. To select another label library, press the **Next Library** soft key (**F1**) to toggle between the libraries.
3. A set of labels (some of which may be empty) is displayed.
4. To place a label on the display, use the trackball to highlight the required label and press the ☞ control.
5. Use the trackball to position the label.

The selected label can be edited using the keyboard. Editing a displayed label does not influence the label text in the library.

While a label library is shown, the soft menu in Fig. A29 is displayed. The ↶ control lets you return to the main menu.

Next Library		Label Setup		
F1	F2	F3	F4	F5

Fig. A29. The Label Library menu

To add or change a label in the label library:

1. Press the **Next Library** soft key (**F1**) to choose the label library to be edited.
2. Select the appropriate label using the trackball.
3. Enter the new text using the keyboard.
4. Press ↵ on the keyboard to accept the new text.

Label Setup Functions

Press **Label Setup (F3)** on the Label Library menu (Fig. A29) to display the label setup page. From this page you can choose the initial function of the **Label** control, change label library names, edit fast-labels and enable or disable label libraries.

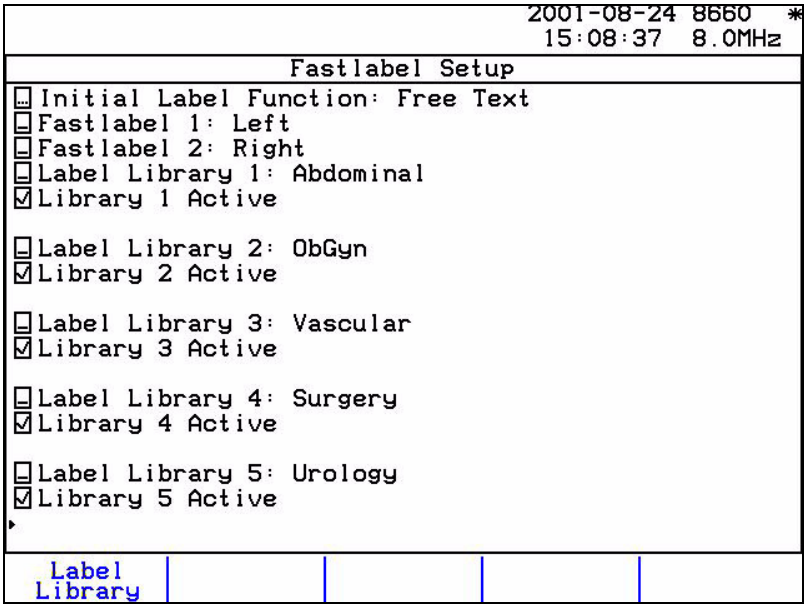


Fig. A30. Label Setup Page

This function allows you to define the initial function of the **Label** control. You can choose between “label library” or “free text”. When the function is set to “label library”, pressing the ABC control will access the label library. When set to “free text” pressing the ABC control will allow you to enter “free text” using the keyboard.

To change the initial label function:

1. Use the trackball to point at the initial label function field on the setup page.
2. Press the ☞ control to toggle between label library or free text.

The name and activation status of each label library can be edited. If a label library is deactivated, its labels will not be displayed for you to choose from.

To enable or disable a label library:

1. Use the trackball to point at the activation status (active or inactive).
2. Press the ☞ control to toggle the status between active or inactive.

To edit the label library name:

1. Press the **Label Setup** softkey to access the label setup page.
2. Use the trackball to point at the library name.
3. Enter a new name using the keyboard.
4. Press ↵ on the keyboard to accept the new text.

To edit the fast-labels:

1. Press the **Label Setup** softkey to access the label setup page.
2. Use the trackball to point at the fast-labels.
3. Enter the new label using the keyboard.
4. Press ↵ on the keyboard to accept the new text.

To delete all labels and comments currently on the monitor, press ABC on the console for more than 1 second.

To reset all the label library texts to the original factory settings in the current language, press <Shift><Alt><ABC>. All previously edited label texts will be deleted.

Orientation ⇄

Press the front panel ⇄ control to display the Orientation soft menu on the monitor (Fig. A31).

U/D	L/R	8551 Axis		
F1	F2	F3	F4	F5

Fig. A31. The Orientation menu

The **U/D** (up/down) and **L/R** (left/right) controls change the orientation of the image, as shown in Fig. A32.

If the transducer Type 8551 is selected, **F3** can be used to toggle the rotation axis indicator on and off.

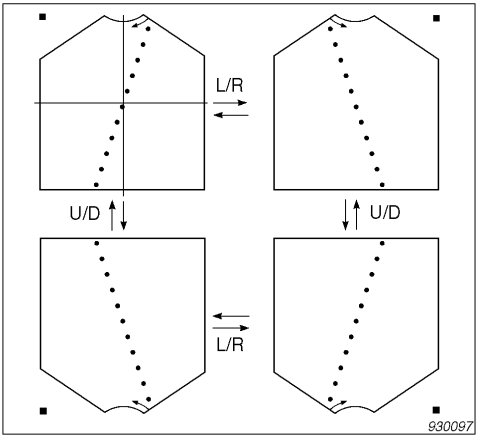


Fig. A32. The U/D and L/R controls change the orientation of the image

Bodymark

This function allows you to place a small icon showing a part of the body on the ultrasound image. There is a bodymark catalogue from which you can choose bodymarks to add to different libraries.

You may have up to 5 libraries, each of which can contain 18 bodymarks. You may customize this function to suit your needs. The selection of bodymarks that appear in each library and the name of each library can be user defined. You can also choose to have a bodymark library deactivated so that it is not available for selection.

Select and Place a Bodymark:

Press the ⟆⟅ control on the front panel. If no bodymarks have been selected, the last used bodymark library is displayed. See Fig. A33 for an example.

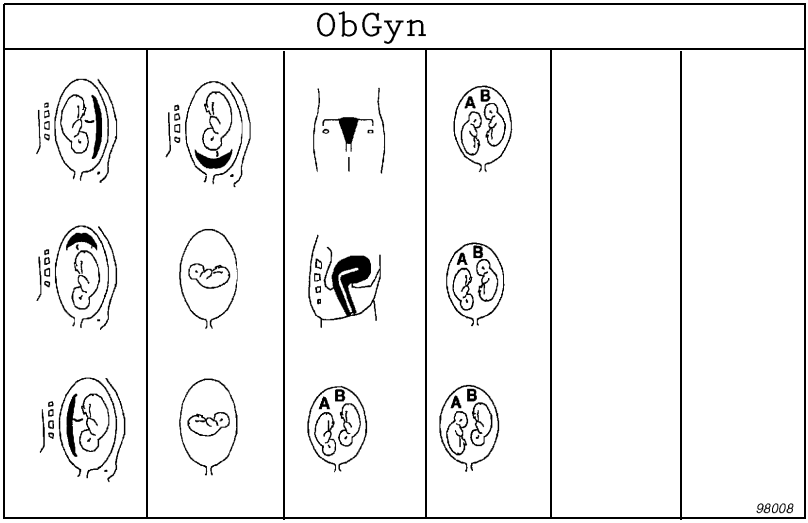


Fig. A33. An example of a bodymark library

1. Use the trackball and press the ☞ control to select the required bodymark. Where the bodymark selected forms one half of a pair (e.g. left and right breast; torso from the front and from the back), pressing the ⟆⟅ control for a second time enables you to switch to the other half of the pair. The soft menu Fig. A34 is displayed and a scanning plane indicator is displayed on the monitor.

		Bodymark select		
F1	F2	F3	F4	F5

Fig. A34. Soft menu for rotation of the scanning plane indicator

2. Use the trackball to position the scanning plane indicator.
3. Use the soft keys (**F1**) and (**F2**) to rotate the scanning plane indicator.

The scanning plane indicator can also be rotated by using the trackball. Press the ☞ control and then rotate the plane indicator using the trackball. The ☞ control can be used to toggle between moving and rotating the scanning plane indicator. One end of the scanning plane indicator is marked with a small circle. This can be used to indicate transducer orientation.

4. To set the scanning plane in a vertical position, use the Vertical soft key (**F4**). To set the scanning plane in a horizontal position (default) use the Horizontal (**F5**) soft key. The scanning plane indicator moves accordingly.

To select a different bodymark from another library, press **Bodymark Select** (**F3**) to display the Bodymark selection page (Fig. A33) and the bodymark selection menu Fig. A35.

Next Library		Bodymark setup	Insert bodymark	Delete bodymark
F1	F2	F3	F4	F5

Fig. A35. Bodymark selection menu

Press **Next Library** (**F1**) to display the next library and select the required bodymark using the trackball and the ☞ control.

Inserting a Bodymark in a Library

1. Press **Insert Bodymark** (**F4**) to display the Bodymark Catalogue.
2. Press **Next Library (F1)** to toggle through the pages of available bodymarks.
3. Choose and add the required bodymark by using the trackball and the ☞ control.

Removing a Bodymark from a Library

Select the bodymark to be removed using the trackball and the ☞ control, then press **Delete bodymark (F5)**.

Bodymark Setup

Press **Bodymark Setup (F3)** to on the Bodymark Selection menu (Fig. A35) to display the Bodymark setup page. From this page you can change bodymark library names and enable or disable bodymark libraries.

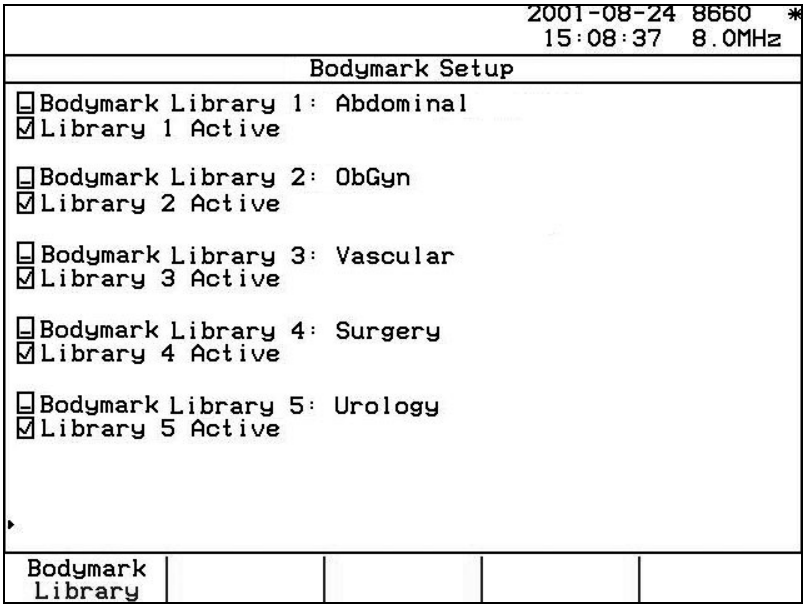


Fig. A36. Bodymark Setup Page

The name and activation status of each bodymark library can be edited. If a bodymark library is deactivated, its bodymarks will not be displayed for you to choose from.

To enable or disable a bodymark library:

1. Use the trackball to point at the activation status.
2. Press the ☞ control to toggle between active or inactive.

To edit the Bodymark library name:

1. Press the **Bodymark Setup** softkey to access the bodymark setup page.
2. Use the trackball to point at the library name.
3. Enter a new name using the keyboard.
4. Press ↵ on the keyboard to accept the new text.

To remove a displayed bodymark, press the ⇳ control for more than 1 second.

Other Front Panel Controls

Description of the use of other front panel controls including measure, angle, image, focus, gain, storage, review can be found in Section B.

Foot Switch

There is a two pedal foot switch that can be used for operating different functions on the scanner. The foot switch is operated by pressing down on a pedal. Releasing the pedal again does not operate or reverse the function.

The right pedal is dedicated to the **Freeze/Unfreeze** function. Pressing the right foot pedal once will freeze an image and pressing it again will unfreeze the image.

The left pedal can be programmed to activate a range of different functions. This is determined in your user setup. See Section A.2 “Customizing Your System”. The following functions can be chosen for the left pedal:

Function	Description
Video Printer Copy	Copy to video printer
Simultaneous / Full screen	Toggle between full screen and simultaneous biplane when using Transducer Type 8808
Scan plane toggle	Toggle between S and T planes when using Transducer Types 8808 and 8658
Image Storage	Start image storage
Biopsy Line	Toggle the puncture line on and off
Measure	Start calculation
MFI	Change transducer frequency
Arrow	Place an arrow on the image
Label	Enter label text
Label Library	Display label library
Bodymark Library	Display bodymark library

Fig. A37. Choice of functionality for the foot switch left pedal.

A.4 Palm Control Unit (PCU)

An optional Palm Control Unit (PCU) can be used for remote operation of the scanner (see Fig. A38).

Fig. A38. Palm Control Unit

Note: The PCU should not be used, in particular the mouse stick should not be touched, for 12 seconds after the scanner has been turned on (or after connection to the scanner). This is to allow time for the PCU setup.

Mouse Stick

The mouse stick has the same function as the trackball. See "Trackball" earlier in this Section.

Selecting a Transducer

The PCU control has the same function as the control on the front panel.

See in Section A.1 “Getting Started” for further details on transducer selection.

Select Application (Appl)

The PCU control has the same function as the **Appl** control on the front panel. See Section A.3 “The Front Panel Controls”.

Puncture

Press the control to activate the default puncture guide for the selected transducer.

Note: If alternative guides are available for a transducer, a Puncture menu is shown on the monitor (See Fig. A25). Press the corresponding **F** key on the scanner front panel to select a puncture guide.

To remove the puncture guide, press for more than one second.

Picture in Picture (PiP)

This function is inactive and not for use with the 2101EXL Premium ultrasound scanner.

Orientation

Press the control to toggle the image left/right.

Note: To toggle the image up/down, press the control on the scanner front panel to display the Orientation soft menu on the monitor. Press the corresponding **F** key to select image up/down. See Section A.3 “The Front Panel Controls”.

Size

The PCU control has the same function as the control on the front panel. See Section A.3 “The Front Panel Controls”.

B-mode

Press the **B** control to scan in B-mode.

B Gain

Press the up/down control to increase or decrease the gain of the entire B-mode image.

For a more detailed description of the Gain and TGC (Time Gain Compensation) controls, See Section B.1 “B-mode Imaging”.

Freeze

The PCU control has the same function as the control on the front panel. See “Freeze” earlier in this Section.

Pressing the control for more than one second will activate the **Copy** function. See “Freeze” earlier in this Section.

Pointer

The PCU control has the same function as the control on the front panel. See “Pointer” earlier in this Section.

Distance

Pressing the control will place a set of distance markers on the monitor, one of which can be moved using the mouse stick. Pressing the control again will give an extra set of markers.

See Section B.3 “Making a Measurement”. for full details on how to make measurements.

Color Box/Doppler Gate

This control cannot be used with this scanner.

Range

This control cannot be used with this scanner.

CFM/Power

This control cannot be used with this scanner.

Duplex/Triplex

This control cannot be used with this scanner.

Color Gain

This control cannot be used with this scanner.

Sterile Covers

Sterile covers are available for use with the PCU. The procedure for fitting the sterile covers is shown in Section G.2 “Disinfection”.

A.5 The Keyboard

Patient Identification

To enter a new patient identification:

1. Press the **ID** control on the keyboard. The menu shown in Fig. A39 is displayed with **New ID** (**F1**) selected.

New ID	Edit ID		Partial Reset	Full Reset
F1	F2	F3	F4	F5

Fig. A39. The ID menu

2. Use the keyboard to type in a patient identification, then press ↵ (Enter).

Note: Pressing ↵ (Enter) to accept a new ID will perform a full reset of the scanner. In appropriate cases a Partial Reset can be performed as described below.

To edit a patient identification that is already on the screen:

1. Press the **ID** control. The menu shown in Fig. A39 is displayed. The existing patient identification is cleared from the screen and replaced by a cursor.
2. Press **Edit ID** (**F2**). The ID will reappear on the screen.
3. Use the keyboard to edit the patient identification, then press ↵ .

Partial Reset and Full Reset

Partial Reset (**F4**) can be used to accept a new ID while retaining the image settings, for example, the image parameters and body-mark selection. However, the scanner is reset to B-Mode and all measurements will be cleared.

To use the Partial Reset function, follow the procedure for entering or editing an ID, as described above, but Press (**F4**) **Partial Reset** instead of ↵ to accept the ID.

Full Reset (**F5**) performs a full reset. The scanner is reset to the currently selected application setup and all measurements will be cleared.

Caution:

To ensure that documentation carries the correct patient identification, it is important to enter a new patient identification before scanning a new patient.

Patient ID is **not** retained when the scanner is switched off.

Section B

Operation

B

B.1 B-mode Imaging 1

B Gain/TGC 1
Image 2
Persistence 2
Rate 2
Strong and Composite Focus 3

B.2 B+M-mode 3

Setting Thermal Indices 4
M Gain 4
Adjusting the Gray Scale 4
Sweep Speed 5

B.3 Making a Measurement 5

Distance 5
The Measure Menu 6
HWL 7
Angle 8
Draw 9
Volume 9
Ellipse 11
Circle 11
Heart Rate (HR) 12

B.4 Image Review 13

B

B.1 B-mode Imaging

The **B/M** control on the front panel is used for toggling between B and B+M-mode. When in B-mode, you can also press <M> on the keyboard to go to M-mode. When in M-mode, you can also press <B> on the keyboard to go to B-mode.

B Gain/TGC

The **Gain** dial controls and **TGC** slide controls on the console are used to adjust the TGC (Time Gain Compensation) curve. The TGC curve determines the amplification applied to ultrasound echoes from different depths in the tissue. In this way, the TGC function compensates for damping and scattering of the ultrasound beam in the tissue.

When you select a transducer for scanning, the scanner automatically sets up a TGC curve optimized for this transducer (either the factory setting or a user setup). The TGC sliders must be centered to get the optimized curve. The Gain curve can be modified using the **Gain** and **TGC** controls.

Gain

The larger **Gain** dial control adjusts the gain of the entire B image. Turn the control clockwise to increase the gain and counterclockwise to decrease it. The currently selected gain setting is shown on the monitor (BG).

TGC

The TGC slide controls adjust the gain of a specific part of the image. Each slide control adjusts a specific portion of the curve; the topmost control adjusts the one eighth of the image which is at the top of the screen. The slide controls operate relative to their center position; when they are centered, the TGC is unaltered from the stored transducer setup.

Move the slide controls to the right or left to adjust the TGC curve.

When a **TGC** control is activated, a TGC curve appears on the monitor. This curve indicates the modification of the TGC curve applied by means of the 8 sliders on the front panel. All 8 sliders affect actual image size and orientation.

B

Image

Press the front panel control. The soft menu shown in Fig. B1 is displayed on the monitor.

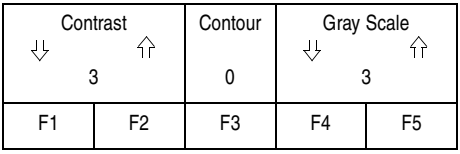


Fig. B1. The Image soft menu

Contrast

The contrast function lets you select a contrast setting for the ultrasound image. Press the **Contrast** and soft keys (**F1** and **F2**) to adjust the level of contrast. There are 6 levels; the number of the currently selected level is shown on the soft key.

Gray Scale

This function lets you change the gray scale used for the B-mode image. Press the **Gray Scale** and soft keys (**F4** and **F5**) to adjust the gray scale. Ten different gray scales are available. The selected gray scale is momentarily displayed after pressing **Gray Scale**. The number of the currently selected gray scale is shown on the soft key. A gray scale mapping curve is displayed on the screen for 5 seconds.

Contour

This function lets you select the level of contour enhancement. Press the **Contour** soft key (**F3**) to step through one of three levels; 0, 1 or 2.

Persistence

This function lets you choose a level of time averaging to be applied between B-mode frames. Press the up/down hard key on the front panel to adjust the level of averaging. The persistence level is displayed on the monitor (0 is no averaging and 5 is maximum averaging).

Rate

The frame rate function lets you adjust the motor speed for mechanical sector transducers, thereby adjusting the frame rate,

or number of images per second. Increasing the frame rate increases the update rate for the ultrasound image.

For array transducers, the frame rate is increased by narrowing the scanning field.

Press the up/down control on the front panel to adjust the frame rate. The currently selected frame rate (FR) is shown on the monitor.

Strong and Composite Focus

When this function is active, the ultrasound image is focused very sharply in a selected zone, while the rest of the image is not as well-focused. You can select the number of focal zones used. The scanner can either use a single focal zone or multiple (up to 4) focal zones (composite focusing). When more than one focal zone is active, ultrasound beams are focused at different depths in the tissue, thereby improving the focus in selected zones. However, the consequence of this is a lower frame rate.

1. Press the control.
2. Use the trackball to select the desired focus depth of the ultrasound beam. A marker in the image field indicates the position of the focus.

If the trackball has been used for other functions while the strong focus function is active, press for less than 1 second to return the trackball to the strong focus function.

3. Press the control again to toggle between the number of focal zones to be used.
4. Press for more than 1 second to deactivate the function.

Note: If a strong focus is used in the transducer setup, the trackball is set to strong focus as default.

B.2 B+M-mode

The **B/M** control on the front panel is used for toggling between B and B+M-mode. When in B-mode, you can also press <M> on the

keyboard to go to B+M-mode. When in B+M-mode, you can also press <B> on the keyboard to go to B-mode.

Setting Thermal Indices

The **Xmit Power** function is used to select and adjust the thermal index limit (TI). Press (≡) to display the Thermal Index menu shown in Fig. B2.

Tissue Type	TI Limit ⇩ ⇧			
F1	F2	F3	F4	F5

Fig. B2. The Thermal Index menu

Selecting **Tissue Type** (**F1**) allows you to toggle between TIS, TIB, and TIC to select the thermal index for soft tissue, bone or cranial tissue respectively. These thermal indices appear on the top left of the monitor. For each tissue type, you can select an upper limit for the thermal index. To change the limits, press ⇩ soft key (**F2**) to reduce and ⇧ (**F3**) to increase limits.

There are 5 thermal index levels to choose from, 1, 2, 3, 5 and 6. The thermal index and the thermal index limit are displayed on the monitor.

M Gain

The smaller **Gain** dial control lets you adjust the level of the overall gain for M-mode. Turn the control clockwise to increase the gain and counterclockwise to decrease it. This curve indicates the modification of the TGC curve applied by means of the 8 sliders on the front panel. The currently selected gain setting is displayed on the screen.

To adjust the B-mode gain, see instructions in Section B.1 “B-mode Imaging”.

Adjusting the Gray Scale

To adjust the gray scale of the M-mode image when scanning in B+M-mode, press the ⌊⁄ control on the front panel. The soft menu shown in Fig. B1 is displayed on the monitor.

Press the **Gray Scale** soft keys (**F4** and **F5**) to toggle between 3 different gray scales. The selected gray scale is momentarily displayed after pressing **Gray Scale**. The number of the currently selected gray scale is shown on the soft key.

Note: The B-mode gray scale can only be changed when scanning in B-mode alone (see Section B.1 “B-mode Imaging”).

Sweep Speed

This function lets you adjust the sweep speed of the M-mode image.

Press the **Sweep Speed** up/down control on the front panel to adjust the sweep speed of the M-mode image.

B.3 Making a Measurement

This section describes how to measure distances, angles and volumes.

The function of the **Calculator** control on the front panel can be user-defined. It can be set to the same as the Basic Calc, Basic HWL, Uro Calc, Uro HWL, Car Calc or the OB Calc controls. For details on defining this control, see Section A.2 “Customizing Your System”.

Distance

Pressing the **Distance** control on the front panel will place a pair of distance markers on the monitor one of which can be moved using the trackball.

To measure distances:

1. Press . The first distance measure (x) will automatically be activated and ready to be moved.
2. Use the trackball to move the active marker.
3. When the marker is in the desired position, press the control or the control.
4. The next marker is now active and can be moved with the trackball.

(If the trackball has been used for another function, press the distance measurement soft key for less than 1 second to return the trackball to the distance function.)

5. To change a marker's position, use the control to toggle between marker 1 and marker 2.
6. To display additional pairs of markers, press the control again. The maximum number available is 4.
7. You can then use the control to toggle between the displayed pairs of markers.
8. To remove a distance measurement, press the **Delete** control while the distance measurement is selected, or press the control for more than one second.

When scanning in split screen mode, you can make a measurement across the two screen images. This is only possible however if both of the images are the same size and are made with the same transducers.

The Measure Menu

To make a measurement on an ultrasound image, press the **Basic** control (<Q> on the keyboard). The menu shown in Fig. B3 will be displayed on the monitor.

HWL		Draw		
F1	F2	F3	F4	F5

Fig. B3. The Basic Measure main menu

Press the appropriate **F** key to select the type of measurement you want to make.

Note: The Basic Measure main menu can also be accessed by using the **Calculator** control , provided that the Default Calculator Button function is set to **Basic**. (See Section A.2 "Customizing Your System").

HWL

Press **HWL** (**F1**) on the Basic Measure menu (Fig. B3) to display the HWL menu (Fig. B4).

× x_H	+ $+_W$	◇ $◇_L$	Factor	
F1	F2	F3	F4	F5

Fig. B4. HWL menu

Pressing **F1**, **F2** and **F3** will give you three sets of distance markers which you can use to make an HWL (based on Height Width Length) calculation. These markers will keep their values during an image recording session.

To make a height measurement:

1. Press the **Height** soft key (**F1**). Two markers appear on the monitor; one is active.
2. Use the trackball to move the active marker.
3. When the marker is in the desired position, press ☞. The other marker is now active.
4. Use the trackball to position the marker.

The Height measurement is now complete. To reposition one of the markers, use the ☞ control to toggle between them.

To make a Width measurement, press **F2** and follow the instructions for Height measurements.

To make a Length measurement, press **F3** and follow the instructions for Height measurements.

Once the three measurements have been made, the volume is automatically calculated.

To change the factor that is used in the HWL calculation:

1. Press **Factor (F4)**.
2. Enter the new factor using the keyboard and press ↵ .

For more detailed information on using HWL in urology calculations, see Section C.1 “Urology Measurements”.

Angle

The angle function enables you to measure the angle between two lines set up by the first and second and/or the first and third distance measures (+ and ×), as illustrated in Fig. B5. The lines do not have to cross.

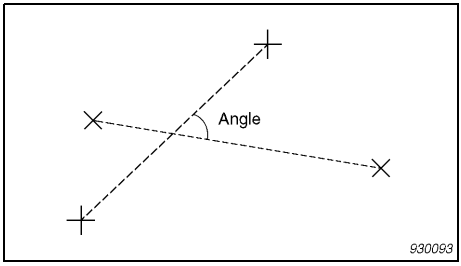


Fig. B5. The angle function

To make an angle measurement:

1. Make two distance measurements.
2. Press the **Angle** soft key (**F2**) on the Basic measure menu (Fig. B3). The distance markers are shown with a line between them.
3. Position the markers as described for Distance. The angle will be measured automatically.

To make a second angle measurement:

Press **F2** and position the third two distance markers. They are joined by a line. The angle between this line and the first line drawn will be displayed on the monitor.

To stop the angle measurement, press the ∠ soft key (**F2**) again. The angle measurement is also turned off when the distance markers are removed.

Draw

To use the Draw function with the trackball:

1. Press the **Draw** soft key (**F3**) on the Basic measure main menu. The Draw/Volume menu (Fig. B6) is displayed on the monitor.

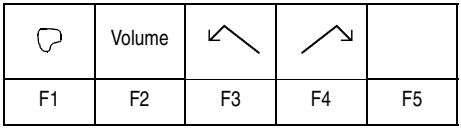


Fig. B6. The Draw / Volume soft menu

2. If no circumference exists on the monitor, the ☜ softkey (**F1)** is automatically activated. Otherwise, press **F1**.
3. Use the trackball to move to the desired starting point.
4. Press the ☞ control.
5. Use the trackball to draw a circumference. While drawing, the ✕ control can be used to erase in a backwards direction.
6. Press the ☞ control to end the drawing.

To remove a drawn circumference, press **Draw** (F3) or ☜ (F1) for more than 1 second.

Volume

This function enables you to make volume calculations based on the convex hull of the Draw circumference measurements. Draw a circumference as described for Draw.

1. Press the **Volume** soft key (**F2** on the Draw/Volume menu in Fig. B6. A rotation axis line is displayed on the monitor, along with the convex hull of the structure. This is the rotation axis which is used for calculating the volume of the structure.

2. Use the ↖ and ↗ soft keys (**F3** and **F4** in the Draw/Volume menu in Fig. B6) to choose the angle for the rotation axis.
3. The volume is calculated and displayed on the monitor.

Note: The axis of rotation has a considerable influence on the calculated volume, refer to Fig. B7. It is important to consider the basic shape of the structure of interest when positioning the rotation axis in order to obtain a reasonable volume estimate.

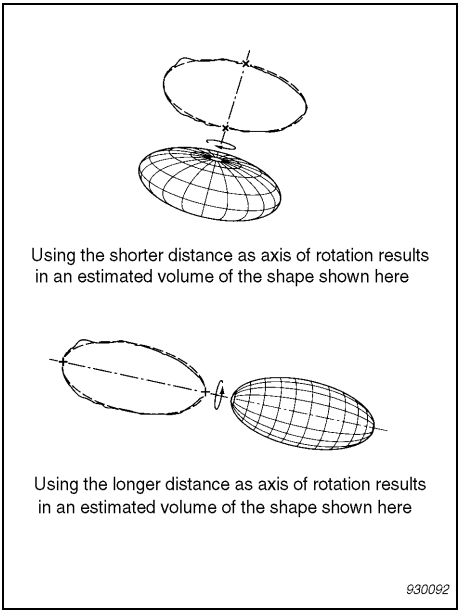

Using the shorter distance as axis of rotation results in an estimated volume of the shape shown here
Using the longer distance as axis of rotation results in an estimated volume of the shape shown here
930092

Fig. B7. The effect of the rotation axis angle on volume determination

To return to the Measure main menu without switching off the volume measurement, press ↶. To end the volume measurement, press the Volume soft key (**F2**) for more than 1 second.

Alternatively, you may remove the circumference drawing in order to end the volume measurement.

Ellipse

The ellipse function ⬭ enables you to you make mean diameter and circumference measurements on elliptic-shaped structures thereby enabling the calculation of the area and volume.

1. Press the ⬭ soft key (**F4** on the Basic Measure menu). An end-point marker (one of the end-points of the ellipse) appears on the screen and is ready to be moved.
2. Use the trackball to move the end-point marker to one end of the organ or structure.
3. Press the ☞ control to obtain the other end-point marker, then use the trackball to move it.
4. Press the ☞ control to obtain the side-point marker. At this point the ellipse is shown. Use the trackball to move the side-point marker. You can toggle through the 3 markers by pressing the ☞ control repeatedly.

If the trackball has been used for another function, press the ⬭ soft key for less than 1 second to regain control of the ellipse function.

Results (mean diameter, area, circumference and volume) are continuously displayed on the monitor while the ellipse is active. The rotation axis used for calculating the volume of the structure is automatically placed between the two end-point markers of the ellipse.

To remove a drawn ellipse, press the ⬭ soft key (**F4**) for more than 1 second.

Keyboard Shortcut

Press <Alt><E> to start ellipse measurement.

Circle

The circle function ○ enables you to make diameter and circumference measurements on circular-shaped structures thereby enabling the calculation of the area and volume.

1. Press the ○ soft key (**F5** on the Measure main menu). A marker appears on the screen and is ready to be moved.
2. Use the trackball to move the marker to the edge of the organ or structure.

3. Press the ☞ control to obtain the other marker. At this point the circle is shown.
4. Use the trackball to move the second marker, and thus adjust the size of the circle. You can toggle between the markers by pressing the ☞ control repeatedly.

If the trackball has been used for another function, press the ○ soft key for less than 1 second to regain control of the circle function.

Results (diameter, area, circumference and volume) are continuously displayed on the monitor while the circle is active.

To remove a drawn circle, press the ○ soft key (**F5**) for more than 1 second.

Heart Rate (HR)

Heart rate can be measured from M-mode images.

To measure heart rate:

1. When you have frozen an image, press the **HR** control (**S** on the keyboard) to display the heart rate soft menu (Fig. B8).

HR	Cycles ⇩ ⇧ 3			
F1	F2	F3	F4	F5

Fig. B8. The heart rate soft menu

2. Two vertical markers appear on the monitor, if not already there; one is a solid line and the other is dotted.
3. Use the trackball to move the active marker.
4. Press the ☞ button to select the other marker.
5. Use the trackball to move the second marker.
6. Use the **Cycles** the ⇩ and ⇧ soft keys (**F2** and **F3**) to set the number of heart rate cycles used in the measurement. The currently selected number of cycles is shown on the **Cycles** soft key (see Fig. B8).

To reposition a marker, use the ☞ button to toggle between the markers.

To delete the heart rate measurement, press **HR** (**F1**) for more than one second.

To return to the Measure main menu, press ↶.

To remove all measurements, press the **Basic** control (**Q** on the keyboard) for more than 1 second. Measurements are also removed when you switch from freeze to record mode, and when you press a calculation control (e.g. **Uro Calc**).

B.4 Image Review

The image review function lets you review a series of the most recently recorded B-mode images while in freeze mode. You can scroll backwards or forwards through the series.

To review the images manually:

1. Press ✱ to stop scanning.
2. Use horizontal trackball movements to scroll through the images.

For automatic image review:

1. Repeat steps 1 and 2 above (the horizontal trackball movement will activate automatic image review).
2. Move the trackball upwards to start the review.
3. To stop the automatic review, move the trackball horizontally again.

If the trackball has been used for other functions, press to return the trackball to the image review function.

When you press the control on the front panel the image review soft menu is displayed (Fig. B9).

Duration				Floppy disk
F1	F2	F3	F4	F5

Fig. B9. The review soft menu (note that the floppy disk option is not active)

Press the **Duration** (**F1**) soft key to determine over what length of time images can be reviewed. To do this you can choose how often images are saved. The more often images are saved, the shorter the period is in which you can review images:

Setting **Duration** to 0 will save every image.
Setting **Duration** to 1 will save every other image.
Setting **Duration** to 2 will save every third image.
Setting **Duration** to 3 will save every fourth image.

Note: Images can only be saved to the hard disk. There is no external storage medium available for this scanner.

Section C

Urology Calculations

C.1 Urology Measurements 1

Getting Started 1
Urology Shortcut Keys 1
HWL 2
Manual Planimetry 3
Automatic Planimetry 5
Empirical Method 7

C.2 Urology Reports 10

Displaying a Report 10
Editing a Report 10
Printing a Report 10
Resetting 11

C

C.1 Urology Measurements

The Urology package contains the measurement and calculation tools and the report facilities for the calculations used in urology.

Getting Started

Press the **Uro** control (<W> on the keyboard) to display a Urology calculation menu (see Fig. C1). Toggle the **Organ** soft key (**F1**) to select the required organ. The following organ types can be selected: prostate, adenoma, kidney, bladder or testis. There are slightly different calculation methods offered depending on the chosen organ. For instance, the empirical method is only offered for the bladder, and manual planimetry is only offered for the prostate and adenoma.

Organ	HWL	Auto Plan	Plan imetry	Report
F1	F2	F3	F4	F5

Fig. C1. The Urology calculation menu for the prostate and adenoma

In all urology measurement menus, you can toggle between different organ types using the **Organ** soft key (**F1**). The name of the organ selected is displayed within the Urology calculation menu (Fig. C1).

Use the soft keys, **F2 – F4**, to select a measurement method. Pressing the soft keys (**F2 - F4**) for more than one second will reset the measurements.

Urology Shortcut Keys

You can define your own set of urology shortcut keys to make access to this calculation package faster.

For instructions on setting these up, see Section A.2 “Customizing Your System”.

HWL

HWL is a measurement method which uses height, width and length measurements to calculate a volume.

To calculate an HWL volume, press **F2** to display the HWL menu (Fig. C2). Press the **Organ** soft key (**F1**) to select an organ; your selection is shown within the HWL menu. Press **F1** again to toggle between the different organs.

The height, width and length measurements must be made at right angles to each other. Therefore, it is necessary to use 2 images for HWL calculations. When it is necessary to record a new B-mode image, press the ⊛ control, or press the transducer's built-in control button to start scanning again.

Organ	× $\times_H$	+ $+_W$	◇ $\diamond_L$	
F1	F2	F3	F4	F5

Fig. C2. The HWL menu

To make a Height measurement:

1. Press the **Height** soft key (**F2**). Two markers appear on the monitor; one is active.
2. Use the trackball to move the active marker.
3. When the marker is in the desired position, press ☞. The other marker is now active.
4. Use the trackball to position the marker.

The height measurement is now complete. To reposition one of the markers, use the ☞ control to toggle between them.

To make a Width measurement, press **F3** and follow the instructions for Height measurements.

To make a Length measurement, press **F4** and follow the instructions for Height measurements.

Once the three measurements have been made, the volume is automatically calculated as described in Appendix 3, and results are displayed on the monitor and entered into the Urology report.

Press the **HWL (F2)** soft key for more than one second to remove the measurement from the screen and the report.

Press ↶ to go back to the Urology main menu.

Manual Planimetry

For this method, a number of parallel B-mode images are recorded which cover the organ to be measured. The volume of the structure is then estimated based on these parallel sections. Stepping units are available for use with Biplane Transducer Type 8658. The stepping unit controls the spacing between sections.

It is important for the accuracy of this method that the correct starting point for these measurements is used. The starting point should be at one end of the organ where the display on the monitor shows an area of as close to 0 as possible (see Fig. C3). The next scan is taken at the next step, and the system will calculate the volume between the starting point and the new scan (see Fig. C3). A volume or surface area cannot be calculated until at least 2 scans have been analyzed. This is continued until the whole organ has been covered and a total volume obtained.

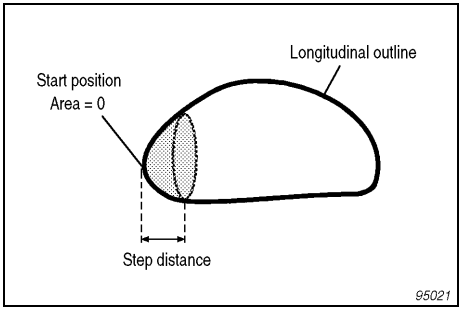


Fig. C3. Longitudinal outline of organ showing the start position for planimetry

The planimetry method is only available for the prostate and adenoma.

To make a planimetry calculation:

1. From the Urology calculation menu (see Fig. C1) and press **Planimetry** (**F4**) to display the Planimetry menu (see Fig. C4).

Organ			Step Size	Reset
F1	F2	F3	F4	F5

Fig. C4. The planimetry menu

2. Press the **Step Size** soft key (**F4**), then use the keyboard to enter a step size that matches the displacement of the transducer between measurements.
3. Record a B-mode image at one end of the organ. Press the ⊛ control on the front panel or press the transducer's built-in control button to freeze the image.

You can use the draw function or the ellipse function for planimetry measurements. The draw function lets you draw a circumference of any shape. The ellipse function can be used for elliptic sections.

Draw

4. Press the softkey (**F2**).
5. Use the trackball to move to the desired start position (see Fig. C3), then press .
6. Trace the circumference using the trackball. While tracing, the ✕ control can be used to erase in a backwards direction.
7. Press to end the drawing.
8. Unfreeze the image and record a new B-mode image at the next step.
9. Repeat steps 4 through 8 until the entire organ has been outlined.

To remove a drawn circumference, press its soft key (**F4** in the planimetry menu) for more than 1 second.

Ellipse

When using the Ellipse function for planimetry measurements, steps 1 through 3 are the same as in the Draw function:

4. Press the ⬭ soft key (**F3**). An end-point marker (one of the end-points of the ellipse) appears on the screen and is ready to be moved.
5. Use the trackball to move the end-point marker to one end of the organ or structure.
6. Press ☞ to obtain the other end-point marker, then use the trackball to move it.
7. Press ☞ to obtain the side-point marker. At this point an ellipse is shown. Use the trackball to move the side-point marker. You can toggle through the 3 markers by pressing ☞ repeatedly.
8. Unfreeze the image and record a new B-mode image at the next step.
9. Repeat steps 4 through 8 until the entire organ has been outlined.

The volume is automatically calculated as described in Appendix 3, and results are displayed on the screen and entered into the Urology report.

To remove the drawn ellipse, press its soft key for more than 1 second.

The **Reset** soft key (**F5**) or the **Planimetry** (**F4**) soft key (on the Urology main menu) clears all area measurements made in the current planimetric measurement session (except in the report).

The ↶ control brings you back to the Urology main menu.

Automatic Planimetry

Automatic planimetry is a measurement method in which orthogonal transverse and longitudinal B-mode area measurements form the basis for a simulated planimetry volume calculation.

Press the **Autoplan** soft key on the Urology main menu to display the Automatic Planimetry menu shown in Fig. C5.

Organ	AT	AL	AT	AL
F1	F2	F3	F4	F5

Fig. C5. The Automatic Planimetry menu

When making measurements for automatic planimetry, you can choose between the Draw function or the ellipse function .

Note: *For automatic planimetry calculations, the transverse outlined area must represent the shape of the organ.*

Draw

To perform automatic planimetry using the Draw function:

1. Press AT (**F2**) to draw an outline in the transverse B-mode image.
2. Use the trackball to move to the desired start position, then press .
3. Trace the circumference of the transverse image using the trackball. While tracing, the ✕ control can be used to erase in a backwards direction.
4. Press to end the drawing.
5. Record a longitudinal image at a right angle to, and from the same transducer position as, the transverse image.
6. Press **F3**.
7. Use the trackball to move to the desired start position, then press .
8. Trace the circumference of the longitudinal image using the trackball.
9. Press to end the drawing.

Ellipse

To perform automatic planimetry using the Ellipse function:

1. Press AT (**F4**) to make an ellipse measurement on a transverse image. An end-point marker (one of the end-points of the ellipse) appears on the screen and is ready to be moved.

2. Use the trackball to move the end-point marker to one end of the organ or structure.
3. Press the ☞ control to obtain the other end-point marker, then use the trackball to move it.
4. Press the ☞ control to obtain the side-point marker. At this point the ellipse is shown. Use the trackball to move the side-point marker. You can toggle between the 3 markers by pressing ☞ repeatedly.
5. Record a longitudinal image at a right angle to, and from the same transducer position as, the transverse image.
6. Press AL (**F5**) to make an ellipse measurement on a longitudinal image. An end-point marker appears on the screen and is ready to be moved.
7. Use the trackball to move the end-point marker to one end of the organ or structure.
8. Press ☞ to obtain the other end-point marker, then use the trackball to move it.
9. Press ☞ to obtain the side-point marker. At this point the ellipse is shown. Use the trackball to move the side-point marker.

To remove the drawn ellipse, press its soft key for more than 1 second.

You can switch between ⬭ and ⬭ during automatic planimetry measurements. For example, you might use ⬭ for the transverse measurement and ⬭ for the longitudinal measurement.

The volume is calculated as described in Appendix 3, and results are displayed on the screen and entered into the Urology report.

Press the **Autoplan** (**F3**) soft key for more than one second to remove the measurement from the screen and the report.

To return to the Urology main menu, press the ↶ control.

Empirical Method

The empirical method is a measurement method in which orthogonal transverse and longitudinal B-mode area measurements form the basis of the volume calculation.

The empirical method is only valid for the bladder.

Use the **Organ** soft key (**F1**) to select the bladder. Press the **Empiric** soft key (**F4**) to display the Empirical menu shown in Fig. C6.

Organ	AT	AL	AT	AL
F1	F2	F3	F4	F5

Fig. C6. The Empirical menu

When making measurements for empirical method calculations, you can choose between the Draw function or the Ellipse function .

Note: *When outlining the bladder for the empirical method, the outlines must represent the maximum areas of the bladder in the transverse plane and longitudinal plane.*

Draw

To perform empirical method calculations using the draw function:

1. Press AT (**F2**) to draw an outline in the transverse B-mode image. An active marker appears.
2. Use the trackball to move to the desired start position, then press .
3. Trace the circumference of the transverse image using the trackball. While tracing, the control can be used to erase in a backwards direction.
4. Press to end the drawing.
5. Record a longitudinal image at a right angle to, and from the same transducer position as, the transverse image.
6. Press AL (**F3**).
7. Use the trackball to move to the desired start position, then press .
8. Trace the circumference of the longitudinal image using the trackball.
9. Press to end the drawing.

Ellipse

To perform empirical method calculations using the Ellipse function:

1. Press AT (**F4**) to make an ellipse measurement on a transverse image. An end-point marker (one of the end-points of the ellipse) appears on the screen and is ready to be moved.
2. Use the trackball to move the end-point marker to one end of the organ or structure.
3. Press ☞ to obtain the other end-point marker, then use the trackball to move it to the other end.
4. Press ☞ to obtain the side-point marker. At this point the ellipse is shown. Use the trackball to move the side-point marker. You can toggle through the 3 markers by pressing ☞ repeatedly.
5. Record a longitudinal image at a right angle to, and from the same transducer position as, the transverse image.
6. Press AL (**F5**) to make an ellipse measurement on a longitudinal image. An end-point marker appears on the screen and is ready to be moved.
7. Use the trackball to move the end-point marker to one end of the organ or structure.
8. Press ☞ to obtain the other end-point marker, then use the trackball to move it to the other end.
9. Press ☞ to obtain the side-point marker. At this point the ellipse is shown. Use the trackball to move the side-point marker.

The volume is calculated as described in Appendix 3, and results are displayed on the screen and entered into the Urology report.

To remove the drawn ellipse, press its soft key for more than 1 second.

Press the **Empiric** (**F4**) soft key for more than one second to remove the empirical measurements from the screen and report.

You can switch between ⬭ and ⬭ during empirical method measurements. For example, you might use ⬭ for the transverse measurement and ⬭ for the longitudinal measurement.

To return to the Urology main menu, press the ↶ control.

C.2 Urology Reports

Displaying a Report

Press the **Report** soft key (**F5**) on the Urology main menu to display a report and the Urology Report menu shown in Fig. C7.

Organ	Remark	PSA	PSA Const	TZ Index
F1	F2	F3	F4	F5

Fig. C7. The Urology Report menu

The report will show the latest performed measurement on a selected organ. If adenoma measurements are performed, these are presented in the prostate report.

TZ Index (Transition Zone Index) calculations are only presented in the report if prostate and adenoma volume measurements have been performed.

Editing a Report

Press the **Organ** soft key (**F1** on the Urology Report menu) to toggle between the different organs and make a selection.

Press **Remark** (**F2**) to edit the Remark field of the report, then use the keyboard to type in the text.

Press **PSA** (**F3**) and then use the keyboard to enter a PSA (Prostate Specific Antigen) value. (This is only applicable for the prostate report and for HWL and planimetry calculation methods).

Press **PSA Const** (**F4**) and then use the keyboard to enter or edit the PSA constant value. (This is only applicable for the prostate report and for HWL and planimetry calculation methods).

Printing a Report

While the report is displayed on the monitor, press the control to print the report on a video printer.

Resetting

To reset all urology measurements and clear the report, press the **Uro** control (<W> on the keyboard) for more than 1 second, or enter a new patient ID.

Section D

Cardiac Calculations

D.1 Cardiac Calculations 1

Introduction 1
Definitions 2
Heart Rate (HR) Measurement 2
Getting Started 2
End-diastolic Long Axis (EdL) and End-systolic Long Axis (EsL) Measurement 3
End-diastolic Area (EdA) and End-systolic Area (EsA) Measurement 4

D.2 Cardiac Reports 4

Displaying a Report 4
Editing a Report 5
Printing a Report 5
Resetting 5

D

D.1 Cardiac Calculations

Introduction

A number of measurements can be made on the left ventricle of the heart while scanning in B-mode or M-mode; calculations are then possible using these measurements. Depending on the scanning mode you are using, you will find instructions for making the measurements in the following sections: B-mode in this section and M-mode in Section F.1 “M-mode Measurements”.

The measurements needed for the calculations in B-mode are shown in Fig. D1, and the calculation formulas are listed in Appendix 4.

Calculation	Measurement					Typed Information	
	EdL	EdA	EsL	EsA	HR*	WT	HT
EdV	✓	✓	—	—	—	—	—
EsV	—	—	✓	✓	—	—	—
SV	✓	✓	✓	✓	—	—	—
CO	✓	✓	✓	✓	✓	—	—
EF	✓	✓	✓	✓	—	—	—
SI	✓	✓	✓	✓	—	✓	✓
CI	✓	✓	✓	✓	✓	✓	✓
BSA	—	—	—	—	—	✓	✓

Example: If EsL and EsA are measured (indicated by a tick in the column), then EsV will be calculated.

*HR is measured in B+M Mode

Fig. D1. Measurements possible in B-mode studies, and the calculations in which they are used

Definitions

Possible Measurements

EdL	End-diastolic long axis
EdA	End-diastolic area
EsL	End-systolic long axis
EsA	End-systolic area
HR	Heart rate

Fig. D2. Possible Measurement definitions

Calculations

EdV	End-diastolic volume	Volume of the left ventricle at end-diastole
EsV	End-systolic volume	Volume of the left ventricle at end-systole
SV	Stroke volume (beat volume)	The amount of blood that flows through a cardiac valve during one cardiac cycle
CO	Cardiac output	The volume of blood ejected by the heart in one minute
EF	Ejection fraction (discharge fraction	The fraction of blood ejected from the left ventricle during systole
SI	Stroke volume index	Stroke volume divided by BSA
CI	Cardiac output index	Cardiac output divided by BSA
BSA	Body surface area	Derived from HT and WT input

Fig. D3. Calculation definitions

Heart Rate (HR) Measurement

To calculate the cardiac output (CO) and the cardiac output index (CI), it is necessary to measure the HR. Instructions on HR measurement are given in Section B.3 “Making a Measurement”.

Getting Started

Record and freeze a B-mode image and use the Image Review facility (as detailed in Section B.4 “Image Review”) to choose the frozen B-mode image for the calculations.

Press the **Car** control (<R> on the keyboard) to display the Cardiac main menu (see Fig. D4), and press the soft keys to select a measurement method (**F1 - F4**) or a report (**F5**).

EdL ++	EdA	EsL x x	EsA	Report
F1	F2	F3	F4	F5

Fig. D4. The Cardiac main menu

End-diastolic Long Axis (EdL) and End-systolic Long Axis (EsL) Measurement

To measure EdL:

1. Press **F1**. Two + markers appear on the monitor; one is active.
2. Use the trackball to move the active marker.
3. When the marker is in the desired position, press the ☞ control. The other marker is now active.
4. Use the trackball to position the marker. The EdL measurement is now complete.

To reposition one of the markers:

1. Press the ☞ control to toggle between them.
2. Select the marker you want to reposition.
3. Use the trackball to position the marker. The repositioning of the marker is now complete.

To remove the EdL measurement, press **F1** for more than 1 second, or press the ✕ control while the distance measurement is selected.

After the measurement has been made, the length is shown on the screen and is automatically entered into the Cardiac report.

To make an EsL measurement, press **F3** and follow the instructions for EdL measurement.

End-diastolic Area (EdA) and End-systolic Area (EsA) Measurement

To measure EdA:

1. Press **F2**. A marker appears on the monitor.
2. Use the trackball to move the marker to the desired starting point.
3. Press the ☞ control.
4. Use the trackball to trace the circumference of the EdA. While you are tracing, the ✕ control can be used to erase in a reverse direction.
5. Press the ☞ control to complete the drawing.

To remove the circumference, press **F2** for more than one second.

After drawing the circumference, the area is automatically entered into the Cardiac report.

To make an EsA measurement, press **F4** and follow the instructions for EdA measurements.

D.2 Cardiac Reports

Displaying a Report

Press the **Report** soft key (**F5**) on the Cardiac main menu (Fig. D4) to display a report on the monitor, and to display the Cardiac Report menu shown in Fig. D5.

Height	Weight	Remark		
F1	F2	F3	F4	F5

Fig. D5. The Cardiac Report menu

Editing a Report

Note: If the height and weight of the patient has already been entered in the M Calc Report menu (see Section F.2 “M-mode Reports”), those values will be shown here.

Press the **Height** soft key (**F1** on the Cardiac Report menu) and use the keyboard to type in the patient’s height.

Press **Weight** (**F2**) and enter the patient’s weight.

Press **Remark** (**F3**) to edit the Remark field of the report, then use the keyboard to type in the text.

Press ↶ to go back to the Cardiac main menu.

Printing a Report

Connect an external video printer (EQ 4041), display the report on the monitor and press the 🖶 control to print the report. .

See “Accessories Available” in the Product Data sheet (BP0127) that accompanies this user guide for video printer information.

Resetting

To reset the cardiac measurements (except the height and weight) and clear the report, press the **Car** control (<R> on the keyboard) for more than 1 second.

Section E

Obstetrics Calculations

E.1 General Information 1

E.2 Operation 2

Getting Started 2
LMP 3
Fetal Growth Trend 4
Measuring a Parameter 5
Results 7
Expected FW 7

E.3 OB Setup 8

Getting Started 8
GA 9
FW 10
Other Calculations and Parameters 12
User Defined Methods 13

E.4 OB Reports 19

Displaying a Report 19
Displaying a Curve 20
Editing a Report 21
Bioprofile 21
Printing a Report 22
Resetting 22
References 22

E

E.1 General Information

The Obstetrics (OB) Calculations function offers facilities for calculating the gestational age by ultrasound (GAu), clinical gestational age (GAc) based on LMP or an earlier measurement, fetal weight (FW), and expected day of confinement (EDC). The calculations are based on measurements made on a recorded B-mode image and the date of the patient's last menstrual period (LMP). The results of an earlier examination can be used as a reference instead of LMP.

The calculations can be made using various methods. Each calculation method specifies the input parameters from which the results will be calculated. Input parameters are measured on a recorded B-mode image, and the LMP is typed in.

Once the input parameters required for a calculation method are measured, the calculation is made automatically and entered into the report. For GAu calculations, the results are displayed on the monitor.

The OB function consists of two sections:

- Measurements and calculations.
- User setup.

The system is delivered with a factory setup of calculation methods and measurements to be used in the OB calculations. You can define your own setup using the OB setup section.

Instructions for OB measurements and calculations are given in Section E.2 "Operation". Instructions for defining an OB setup are given in Section E.3 "OB Setup".

The OB function calculates by means of tables and formulas. The tables and formulas used for the various methods are listed in Appendix 5.

The abbreviations used in the OB menus and report are listed in Fig. E1.

ATD – abdominal transverse diameter	APD – abdominal anterior-posterior diameter
MAD – Mean abdominal diameter (ATD + APD)/2	FL/BPD – femur length to biparietal diameter ratio
BPD – biparietal diameter	HC/AC – head circumference to abdominal circumference ratio
HC – head circumference	PL – pes length
AC – abdominal circumference	TBL – tibia length
FL – femur length	AD – abdominal diameter (THAP + TT)/2
CRL – crown rump length	CI – cephalic index average
GS – (GS1 and GS2) gestational sac	FL/AC – femur length to abdominal circumference ratio
TT – transversal thorax	LMP – last menstrual period
THAP – thorax anterior-posterior	FW – fetal weight
OFD – fronto-occipital distance	GAc – gestational age (clinical) GAu – gestational age (by ultrasound)
VL – length of vertebrae	EDCc – expected date of confinement (clinical) EDCu – expected date of confinement (by ultrasound)
FBL – fibula length	AFI - amniotic fluid index

Fig. E1. Abbreviations used for OB measurements and calculations

E.2 Operation

Getting Started

In freeze mode, press the **OB** key (<E> on the keyboard) to display the OB main menu (see Fig. E2).

LMP	BPD CRL FL		AC HC	Report
F1	F2	F3	F4	F5

Fig. E2. An example of an OB main menu

Fig. E2 shows an example of a setup for the OB main menu. The soft keys **F2** – **F4** contain the parameters relevant for the calculation methods.

Note: If you define your own setup (see Section E.3 "OB Setup"), within the OB main menu, the soft keys **F2** – **F4** will contain the parameters for the methods you selected during setup.

LMP

Press the **LMP** soft key (**F1**) to display the LMP page (See Fig. E3)

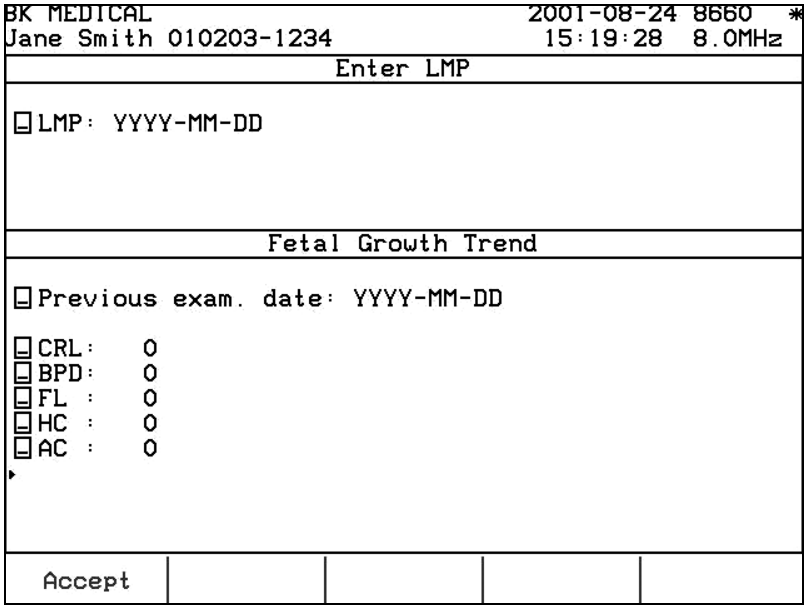


Fig. E3. LMP page

Use the trackball to go to the LMP field; enter the date of the patient's last menstrual period (LMP) using the keyboard. The LMP must be typed using the date format you have selected (see Section A.2 "Customizing Your System"). The LMP is accepted by pressing ↵ on the keyboard.

After entering LMP, the GAc is displayed on the screen.

If **Ob Calc** is selected in your user setup (see Section A.2 "Customizing Your System") as the default measure button function, the

LMP menu page is automatically activated after entering a new patient ID.

Fetal Growth Trend

You can also enter information about previous examinations to produce a fetal growth trend.

On the LMP page (Fig. E3), use the trackball to go to the previous examination date field and enter the date of the patient's last examination using the keyboard. Then move to the field containing the previously measured parameter and enter the value. The GAc will be displayed. The measurement data is plotted on the curve in the report to show a fetal growth trend (see Section E.4 "OB Reports").

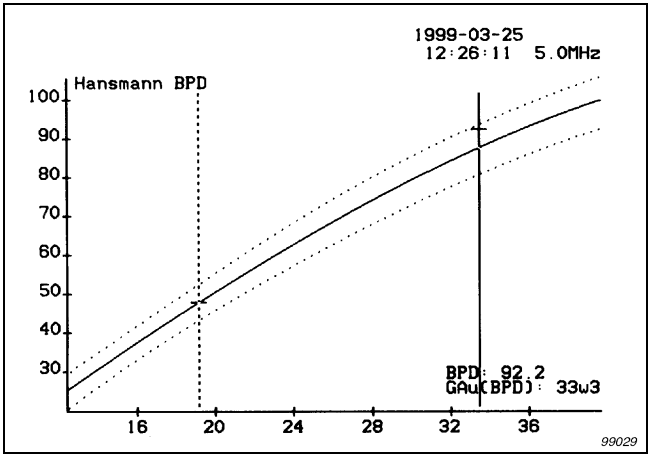


Fig. E4. An example of a fetal growth trend curve

On the curve shown in Fig. E4, the point on the curve shown by its intersection with the dotted line shows the previous examination measurement of BPD, and the curve is calculated with reference to this measurement. The point shown by the intersection with the solid line, shows the currently measured BPD and its position in relation to the expected curve. In the example in Fig. E4, the measured BPD is slightly higher than predicted from the curve, but is still inside the 95% percentile. See Section E.4 "OB Reports" for more information about growth curves.

Measuring a Parameter

Distance

After selecting a function on the OB main menu, a soft menu is shown on the monitor as shown in Fig. E5. To enter a distance measurement, press the soft key corresponding to the parameter you want to measure. For example, if you're using the factory setup, press **F2** to measure **BPD** (Fig. E2). If the result of the measurement exceeds the measurement range for the chosen measurement, this is indicated on the monitor display: >>>> for too high and <<<< for too low.

+ + BPD	+ + CRL	+ + FL		
F1	F2	F3	F4	F5

Fig. E5. An example of a Distance soft menu

1. Press the **F** key for the parameter you want to measure. (For example, to measure **BPD**, press **F1**.) Two markers appear on the image, and one of them is active.
2. Use the trackball to move the active marker.
3. When the marker is in the desired position, press the ☞ control.
4. The other marker is now active.
5. To change a marker's position, use the ☞ control to toggle between marker 1 and marker 2. (If the trackball has been used for another function, press the **Distance** measurement soft key for less than 1 second to return the trackball to the distance function).

To measure another distance parameter, press the appropriate **F** control from the Distance soft menu, then make the distance measurement.

The GA and FW are displayed on the screen, depending on which measurements have been made.

If the LMP has been entered, a GA standard curve is displayed on the monitor while the measurements are being made. The horizontal axis shows the GA, and the vertical axis shows the measurement in mm. A cursor appears on the graph which indi-

cates the position of the parameter being measured and the corresponding GAc. If the cursor appears to the right or left of the graph, the measured value is outside the defined range.

Results are shown on the monitor and entered into the report.

Press ↶ on the control panel to return to the OB main menu.

Circumference

To enter a circumference (HC or AC), press **F4** on the OB main menu (Fig. E2). The soft menu shown in Fig. E6 is shown on the monitor.

AC	AC	HC	HC	
F1	F2	F3	F4	F5

Fig. E6. The Circumference soft menu

To make a measurement using the draw function:

1. Press the soft key for the parameter you want to measure (**F1** for AC, **F3** for HC).
2. Use the trackball to move to the desired starting point.
3. Press the ☞ control.
4. Use the trackball to draw a circumference. While drawing, the ✕ control can be used to erase in a backwards direction.
5. Press the ☞ control to conclude the drawing.

If the LMP has been entered, a GA curve is displayed on the monitor whilst the measurements are being made. A cursor appears which indicates the position of the parameter being measured.

To remove a drawn circumference, press for more than 1 second. This result is also removed from the OB report.

Note: If you want to calculate CI using HC, or calculate AD using AC, you must use the ellipse function to measure HC, not the draw function.

To make a circumference measurement using the ellipse function ⬭:

1. Press the ⬭ soft key for the parameter you want to measure (**F2** for AC, **F4** for HC). An end-point marker (one of the end-points of the ellipse) appears on the screen and is ready to be moved.
2. Use the trackball to move the end-point marker to one end of the organ or structure.
3. Press the ☞ control to obtain the other end-point marker, then use the trackball to move it.
4. Press the ☞ control to obtain the side-point marker. At this point the ellipse is shown. Use the trackball to move the side-point marker. You can toggle through the 3 markers by pressing the ☞ control repeatedly.

Results are displayed on the monitor while the ellipse is active and are entered into the report.

Press ↶ to return to the OB main menu.

Results

When all the input parameters required for a calculation method are measured, the calculation is automatically made, and the results are displayed on the monitor and entered into the OB report.

Expected FW

After LMP or earlier measurement data has been entered and FW has been calculated, a percentage figure appears on the screen next to the FW. This indicates the calculated FW as a percentage of the expected FW for the GA. This expected FW is based on different methods.

You can choose which method/formula to use in your OB user setup (see Section E.3 “OB Setup”). The tables for the different methods can be found in Appendix 5.

E.3 OB Setup

Getting Started

Press **Setup** on the front panel to display the Setup menu shown in Fig. A11 in Section A. Press **OB Set up** (**F5**) to display the OB setup menu (Fig. E7) and an overview of the current OB setup (Fig. E8).

OB Setup Overview	GA	FW	Other Params	User Defined
F1	F2	F3	F4	F5

Fig. E7. OB setup menu

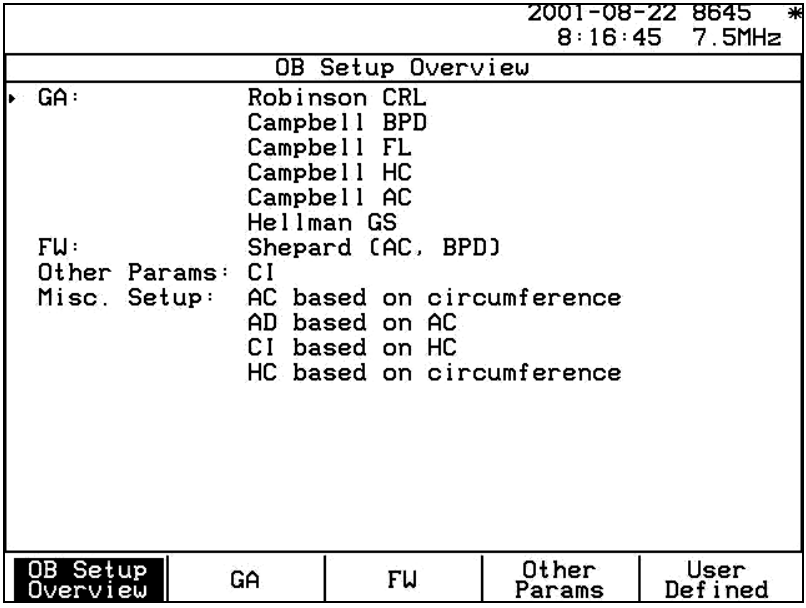


Fig. E8. An example of an OB Setup Overview page

The overview page shows the currently selected items. If the OB calculation package is ON, the overview page will contain the following warning about the use of OB Setup:

If the OB calculation package is ON, changing any parameters in OB Setup will turn off OB Calc and any report data will be lost.

The OB Set up menu (Fig. E7) enables you to select calculation methods and measurement parameters for gestational age (GA) and fetal weight (FW). It also allows you to enter your own user-defined methods for GA and FW calculations. Your setup will override the factory setting.

GA

Press the **GA** soft key (**F2**) to select the methods to be used for calculation of GA. A page of available combinations of methods and measurement parameters is displayed (Fig. E9).

You can select different methods of calculating GA, but the maximum number of parameters that can be used is 10. This also includes "hidden parameters", e.g. if CI is selected and measured from BPD and OFD, BPD and OFD are automatically selected. Only one table may be chosen for each parameter, e.g. if you select Hansmann BPD, and subsequently select Tokyo BPD, Hansmann BPD will be de-selected.

To select a method/parameter, move the trackball to highlight the required selection and use ☞ to toggle the selection on and off.

This page can be extended by up to 6 user-defined methods.

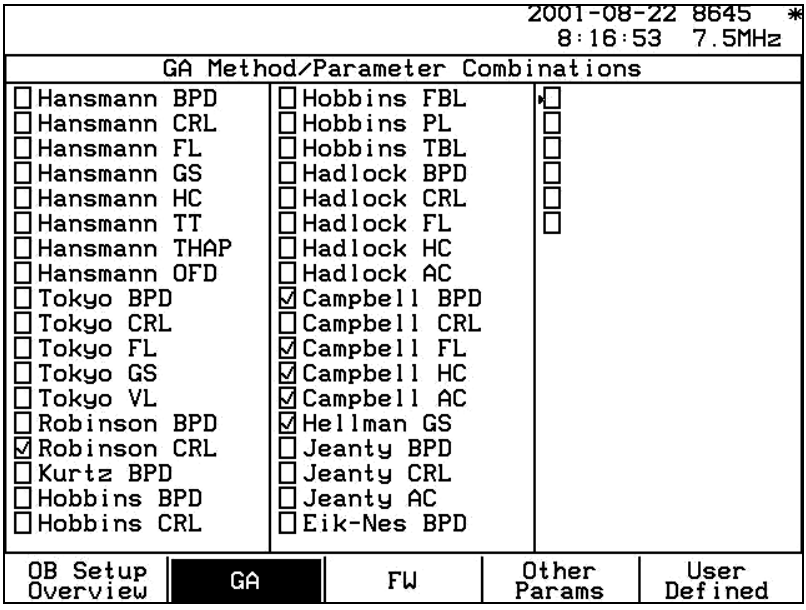


Fig. E9. GA Method/Parameter Combinations page

FW

To select FW calculation methods, press the **FW** soft key (**F3** as shown in Fig. E7). A table of available combinations of methods and measurement parameters is displayed on the monitor (Fig. E10).

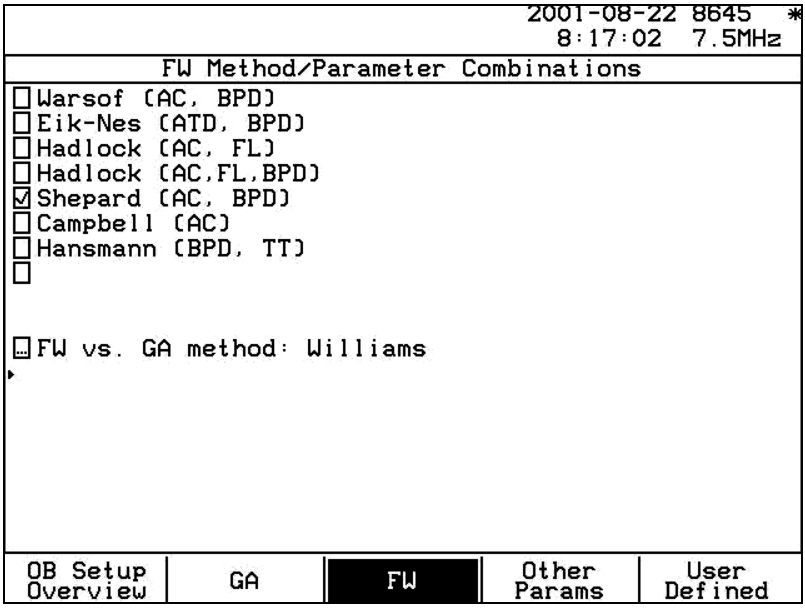


Fig. E10.FW method/parameter combinations

You can only select one method for calculating FW.

To select a method/parameter, move the trackball to highlight the required selection and use ☞ to toggle the selection on and off, as described in Section A.1 “Getting Started”.

The page can be extended to include one user-defined method.

Expected FW method

This allows you to see the FW you have calculated as a percentage of the expected FW. Three different methods are available for calculating the expected FW from GA.

Move the trackball to the FW vs. GA method field and use ☞ to toggle between the different methods, Williams, Osaka or Persson. The tables for the different methods can be found in Appendix 5.

Other Calculations and Parameters

To select other calculation methods, press the **Other Params** soft key (**F4** in Fig. E7). A page of available combinations of methods and measurement parameters is displayed on the monitor (Fig. E11).

To select a method/parameter, move the trackball to highlight the required selection and use ☞ to toggle the selection on and off.

Note: Combinations of calculation parameters that need more than 10 measurement tools cannot be selected. If more than 8 measurements have been selected, only the first 8 (including FW) can be used.

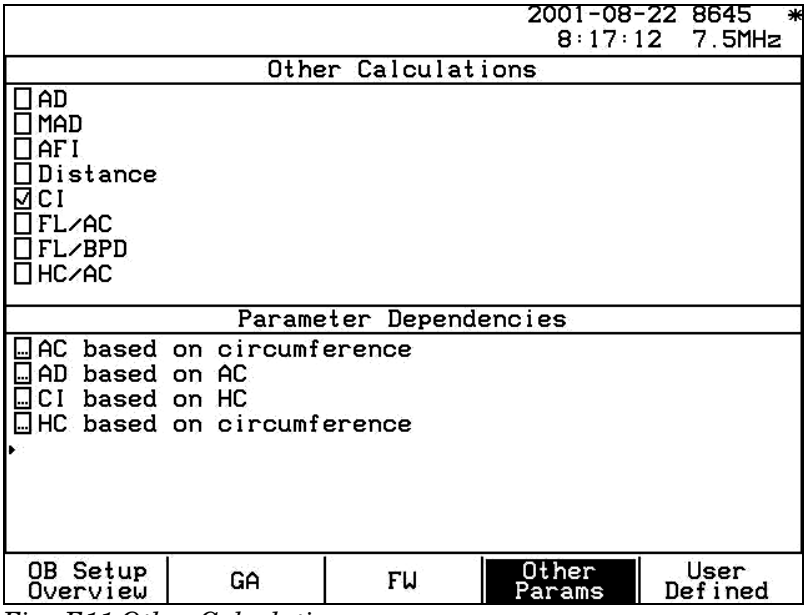


Fig. E11.Other Calculations page

When you select a calculation parameter, the measurement parameters needed for that calculation will automatically be included in the measurement section of the OB function. For example, if you select the Warsof (AC, BPD) method of calculating FW, the AC and BPD method will automatically be included in the OB main menu. Once you measure AC and BPD, the OB

function will automatically calculate FW using the Warsof method (when the measured parameters are within the defined Warsoff range).

A table of parameter dependencies is also displayed. You can toggle between the different dependencies for AC, AD, CI and HC by moving the trackball to highlight the required field and using ☞ to toggle between the different parameter dependencies available (see Fig. E11).

User Defined Methods

Select the **User Defined** option (**F5**) on the OB setup menu (Fig. E7) to display the User Defined page as shown in Fig. E12

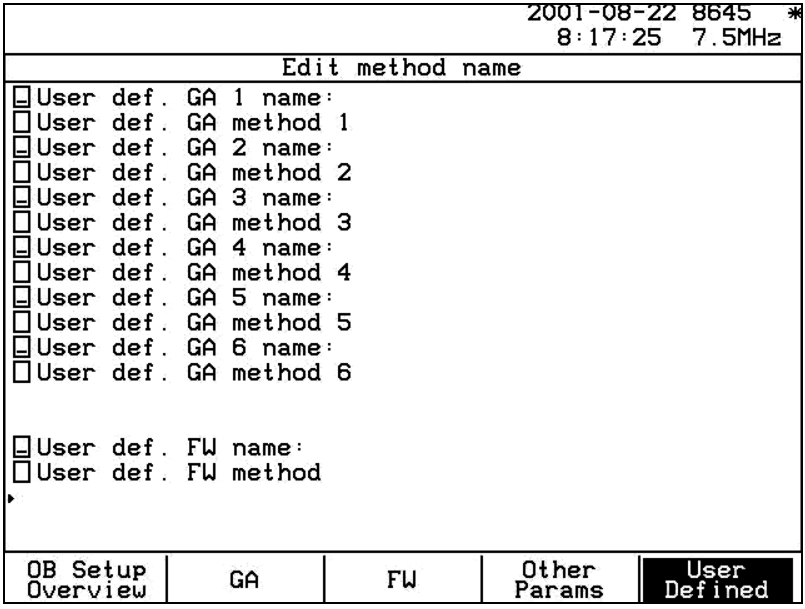


Fig. E12. User defined GA and FW methods and names

This page displays the methods currently defined and spaces for new ones. Using this option you can define different methods of calculation for GA and FW calculations and set parameter dependencies for your methods. You can define up to 6 GA methods and one FW method.

User-Defined GA Method

To enter the name of the method, use the trackball to select the name field, and use the keyboard to enter the new method name or edit an existing name.

To define the method, use the trackball to select the method field and press ☞ .

A list of selectable parameters is displayed (Fig. E13) together with the soft menu (Fig. E14).

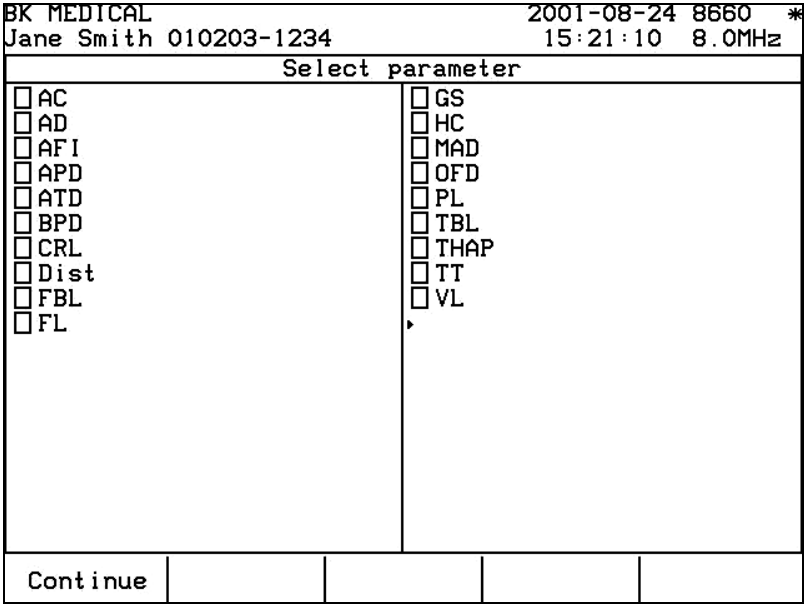


Fig. E13. Select Parameter page.

Continue				
F1	F2	F3	F4	F5

Fig. E14. The Select Parameter menu

Only one selection can be made for each user defined method. To select a method/parameter, move the trackball to highlight the required selection and use ☞ to toggle the selection on and off.

When the selection has been made, press the **Continue** soft key (**F1**) to enter the table values. An empty table (see Fig. E15) is dis-

played on the screen showing the parameter method type (e.g. GAu). The corresponding values can be entered using the keyboard.

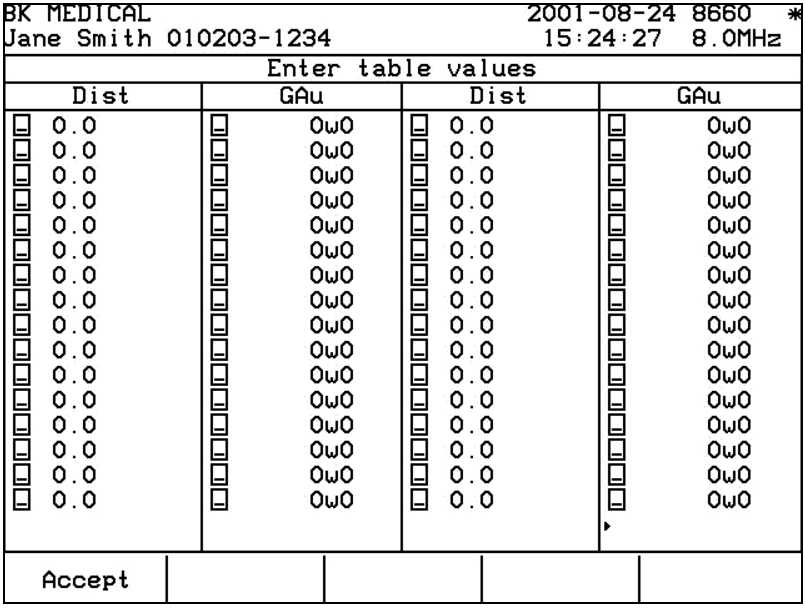


Fig. E15. Example section of the Enter Table Values page

Accept				
F1	F2	F3	F4	F5

Fig. E16. The Enter table values menu

When you have entered the values, press **Accept** (**F1**) on the soft menu Fig. E16 to accept the table.

Press ↶ to return or enter the next method.

User-Defined FW Method

To enter the name of the method use the trackball to select the name field, press ☞ and use the keyboard to enter the new method name or edit an existing name.

To define the method, use the trackball to select the method field and press ☞. The Fetal Weight Equation definition page is displayed, see Fig. E17.

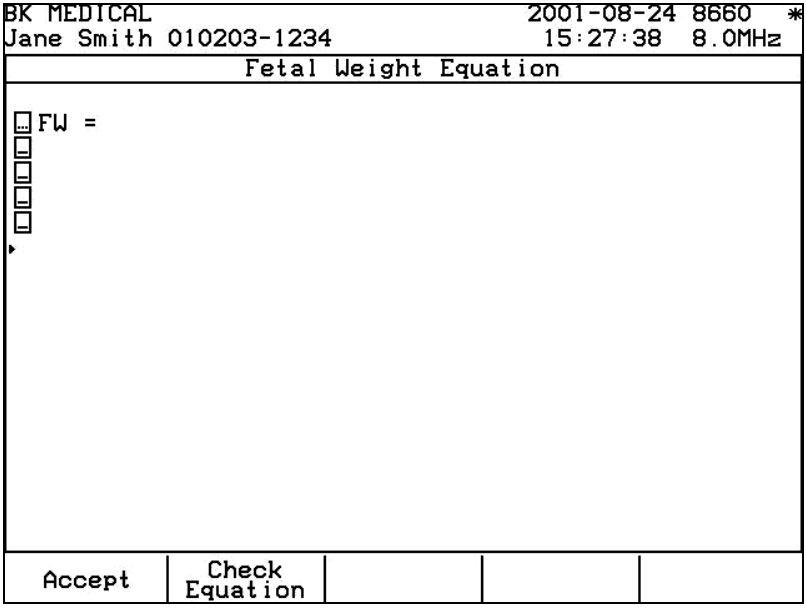


Fig. E17. Fetal Weight Equation definition page

The FW Equation soft menu is also displayed, see Fig. E18.

Accept	Check Equation			
F1	F2	F3	F4	F5

Fig. E18. The FW Equation menu

To enter the fetal weight equation:

1. Use the trackball to go to the first “Equation” line and use the ☞ key to toggle between FW or Log FW.
2. Move the trackball to the next line and use the keyboard to enter the rest of the equation following the list of operators and keys in Fig. E21.

To define the method, use the trackball to select the method field and press ☞. The Fetal Weight Equation definition page is displayed, see Fig. E17.

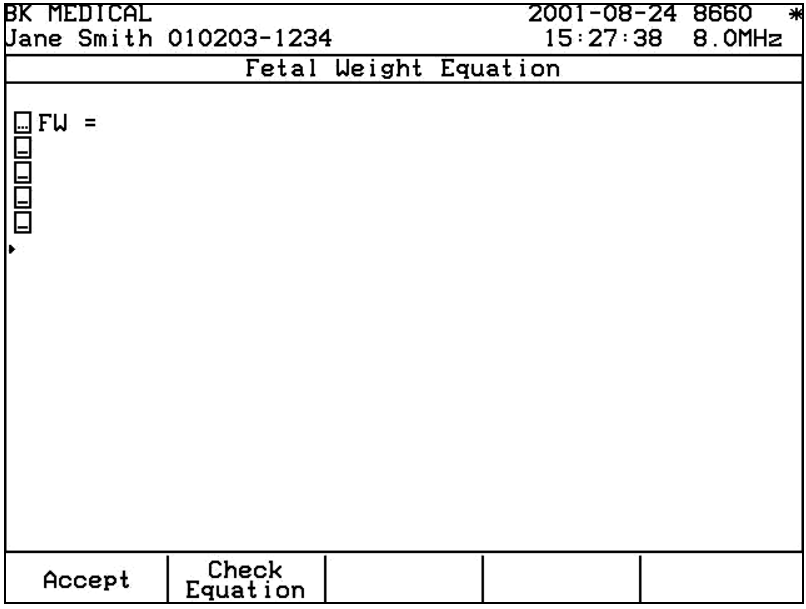


Fig. E19. Fetal Weight Equation definition page

The FW Equation soft menu is also displayed, see Fig. E18.

Accept	Check Equation			
F1	F2	F3	F4	F5

Fig. E20. The FW Equation menu

To enter the fetal weight equation:

1. Use the trackball to go to the first “Equation” line and use the ☞ key to toggle between FW or Log FW.
2. Move the trackball to the next line and use the keyboard to enter the rest of the equation following the list of operators and keys in Fig. E21.

Operator	Key	Example of use
Addition	+	2 + 5
Subtraction	-	6 - 5
Multiplication	*	6 * 5
Division	/	6.3 / 5
Square root	sqrt()	sqrt(21.34)
Exponential	^	3.4^2.1
Natural logarithm	log()	log(29.4)
Inverse logarithm	alog()	alog(0.6931)
Parenthesis	()	2 + (FL * 8.5)
Power of 10	E	1.3E2

Fig. E21. Operators that can be used in fetal weight equations

The number of operators that can be used in an equation is limited only by the space available in the 4 lines on the display.

The constants that can be specified have the following limitations:

- Integer constants must be within the range of -9999999 to 9999999.
- Real constants can only be made up of 7 digits in total.
- Exponents must be within the range of -37.0 to 37.0.
- Power of 10 must be in the range of E0 to E9.

Examples of valid numbers are as follows:

1234.567
-1234567
1.2345E2

The following examples show two different formulas and how you would enter them into the scanner.

Example 1

$$FW = 2.695 + 0.253 \times AC - 0.00275 \times AC^2$$

is entered as

FW = 2.695+0.253*AC - 0.00275*AC^2

Example 2

$$FW = 10^{3.4} \times \log 3.546 + (2.1134 - HC \times FL) + 2.3^{1.24}$$

is entered as

FW = alog(3.4)*log(3.546) + (2.1134-HC*FL) + 2.3^1.24

When you have finished entering the variables for the equation, or while you are entering them, you can check the equation. Press the **Check Equation** soft key (**F2**). The equation is then analyzed and any errors in parsing are displayed on the screen. The cursor will then be positioned at the erroneous entry and the keyboard can be used to edit it. When you have finished entering and checking the equation, press the **Accept** soft key (**F1**).

E.4 OB Reports

Displaying a Report

Press the **Report** soft key (**F5**) on the OB main menu to display a report on the monitor, and to display the OB Report menu shown in Fig. E22.

Report	Curves	Bio profile	Remark	
F1	F2	F3	F4	F5

Fig. E22. The OB Report menu

If there is more than one page of report text, press the **Report** soft key (**F1** on the OB Report menu) to toggle through the pages.

Displaying a Curve

Press the **Curves** soft key (**F2**) to display the GA curve. An example of a GA curve is shown in Fig. E23.

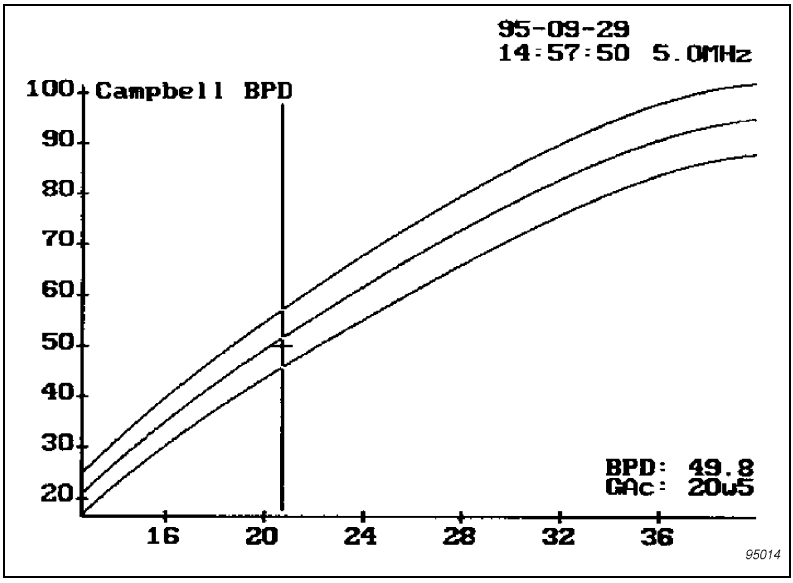


Fig. E23. An example of a GA curve

There are three curves shown for most parameters. The bottom curve indicates the 5% percentile and the upper curve indicates the 95% percentile for the GA method used (statistically 90% of patients lie under the upper curve and above the lower curve). The median curve is the 50% percentile curve.

The calculated GAc is shown on the curve as a vertical line, and a horizontal line shows the measured parameter's position. If more than one measurement has been made, an average of these is shown on the curve.

If more than one GA calculation has been made, press the **Curves** soft key (**F2**) to toggle through the curves.

Note: GAc is used as a reference for the GA curves. Therefore, there must be an LMP, or the entry of an earlier result, to obtain GA curves.

Fetal Growth Trend

If you have entered information about previous examinations and measurements (see Fig. E3), you can see the results from both examinations on the curve. The result of the first examination is plotted on the curve and indicated by a dotted line. This point lies on the curve as this result is used to calculate the curve.

The result from the second examination is shown with an unbroken line. The fetal growth trend can be estimated from the positioning of this line in relation to the GA curve. You can see whether the fetal growth lies outside the 95% percentile for the GA method chosen.

Press the **Report** softkey (**F1**) to return to the report page.

Editing a Report

Press **Remark** (**F4**) to edit the remark field of the report, then use the keyboard to type in the text.

To delete measurements in a displayed report, press <Shift><Alt>**Ob Calc** and the ☞ control to toggle between the measurements to choose the one to be deleted. Press the ✕ control to delete the measurement.

Bioprofile

Press the **Bioprofile** soft key (**F3**) on the OB Report menu to display a list of biophysical parameters [1] and the biophysical profile menu as shown in Fig. E24.

Next	Increase			
F1	F2	F3	F4	F5

Fig. E24. Biophysical Profile menu

The biophysical parameters and their scores are displayed on the screen as shown in Fig. E25.

Biophysical Profile	Score 0-2
Reactive heart rate	
Gross fetal movements	
Fetal breathing movement	
Fetal tone	
Amniotic fluid volume	
Placenta	
Total	

Fig. E25. Biophysical profile parameters

Press **Next** (**F1**) on the Biophysical profile menu in Fig. E24 to toggle between the different biophysical parameters. When the required parameter is selected, enter the scores by pressing **Increase** (**F2**) to toggle between different values from 0 to 2. The total of all the parameters is automatically calculated and displayed in the bottom row of the table.

Printing a Report

Connect an external video printer (EQ 4041), display the report on the monitor and press the control to print the report.

Resetting

To reset all OB measurements and clear the report, press the **OB** control for more than 1 second.

References

[1] Manning et al., American Journal of Obstetrics and Gynecology, 1980;136;787-795.

Other references can be found at the end of Appendix 5.

Section F

M-mode Calculations

F.1 M-mode Measurements 1

Introduction 1
Definitions 2
Heart Rate (HR) 2
Getting Started 3
Basic Measurements (Basic) 3
Left Ventricle (LV) Study 4
Mitral Valve (MV) Study 5
Aortic Valve (AO) Study 6

F.2 M-mode Reports 7

Displaying a Report 7
Editing a Report 7
Printing a Report 8
Resetting 8

F

F.1 M-mode Measurements

Introduction

There are a number of measurements possible on a frozen M-mode recording. The measurements are divided into Basic, Left Ventricle, Mitral Valve and Aortic Valve studies. If the measurements have been made, they will be included in the reports.

B-mode measurements and calculations can be found Section D.1 “Cardiac Calculations”.

Some of these measurements are used to make calculations; the measurements needed for the calculations are shown in Fig. F1 and the calculation formulas are listed in Appendix 4.

Calculation	Measurement					Typed Information	
	IDd	IDs	HR	LAD	AOD	WT	HT
IDd:IDs	✓	✓	—	—	—	—	—
EdV:EsV	✓	✓	—	—	—	—	—
SV	✓	✓	—	—	—	—	—
CO	✓	✓	✓	—	—	—	—
EF	✓	✓	—	—	—	—	—
FS	✓	✓	—	—	—	—	—
SI	✓	✓	—	—	—	✓	✓
CI	✓	✓	✓	—	—	✓	✓
LAR	—	—	—	✓	✓	—	—
BSA	—	—	—	—	—	✓	✓

Example: If IDd, IDs and HR are measured (indicated by a tick in the column), then CO will be calculated.

Fig. F1. Measurements possible in M-mode studies

Definitions

Possible Measurements

IDd	Left ventricle diastolic internal diameter
IDs	Left ventricle systolic internal diameter
LAD	Left atrium diameter
AOD	Aortic root diameter
HR	Heart rate

Fig. F2. Measurement definitions

Calculations

EdV	End-diastolic volume	Volume of the left ventricle at end-diastole
EsV	End-systolic volume	Volume of the left ventricle at end-systole
SV	Stroke volume (beat volume)	The amount of blood that flows through a cardiac valve during one cardiac cycle
CO	Cardiac output	The volume of blood ejected by the heart in one minute
EF	Ejection fraction (discharge fraction	The total volume of blood ejected from the left ventricle during systole
SI	Stroke volume index	Stroke volume divided by BSA
FS	Fractional shortening	The fractional shortening of myocardial fibres during the cardiac cycle is derived from IDs and IDd
LAR	Left atrial/aortic ratio	Left atrium diameter divided by the aortic root diameter
CI	Cardiac output index	Cardiac output divided by BSA
BSA	Body surface area	Derived from HT and WT input

Fig. F3. Calculation definitions

Heart Rate (HR)

To calculate the cardiac output (CO) and the cardiac output index (CI) it is necessary to measure the HR. Instructions on HR measurement are given in Section B.3 “Making a Measurement”.

Getting Started

Record and freeze an M-mode image. Press the **Car** control (<R> on the keyboard) to display the M Calc main menu (see Fig. F4), and press the soft keys to select a measurement method (**F1 - F4**) or a report (**F5**).

Basic	LV ‡ ‡	MV	AO	Report
F1	F2	F3	F4	F5

Fig. F4. The M Calc main menu

Basic Measurements (Basic)

Two sets of cursors for Basic M-mode measurements are available. You can measure distances (Dist 1 and Dist 2), and calculate slopes (Slope 1 and Slope 2) and time differences (dT 1 and dT 2).

Press **F1** (Basic) on the M Calc main menu (Fig. F4) to display the Basic menu (Fig. F5).

Basic1‡	Basic2‡	ET		
F1	F2	F3	F4	F5

Fig. F5. The Basic menu

Basic Measurement 1 (‡)

1. Press **F1** (**Basic 1‡**) on the Basic menu. Two markers appear on the monitor; one is active.
2. Use the trackball to move the active marker.
3. When the marker is in the desired position, press the **Select** ☞ control or **F1** (**Basic 1‡**). The other marker is now active.
4. Use the trackball to position the marker.

The measurement is now complete. To reposition one of the markers, select it by pressing ☞ (or **F1**) to toggle between them. Use the trackball to move the marker.

To delete a distance measurement, press **F1** for more than 1 second, or press the ✕ control while the distance measurement is selected.

Press ↶ to go back to the M Calc main menu.

Basic Measurement 2 (‡)

To make a similar measurement using markers, press **F2** (**Basic 2‡**) and follow the instructions for Basic Measurement 1.

ET

To measure Ejection Time (**ET**):

1. Press **F3** (**ET**). Two lines appear on the monitor; one is highlighted.
2. Use the trackball to move the highlighted line.
3. When the marker is in the desired position, press the ☞ control or **F3** (**ET**). The other line is now highlighted.
4. Use the trackball to position the line.

To reposition one of the markers, select it by pressing the ☞ control (or **F3**) to toggle between them. Use the trackball to move the marker.

To delete the measurement, press **F3** (**ET**) for more than 1 second, or press the ✕ while the measurement is selected.

Press ↶ to go back to the M Calc main menu.

Left Ventricle (LV) Study

The Left Ventricle study uses two pairs of markers – one pair to measure diastolic internal diameter (IDd) and the other to measure systolic internal diameter (IDs), see Fig. F1.

To start the study:

1. Press **F2** (**LV**) on the M Calc main menu (Fig. F4). The *diastolic* cursor will appear on the monitor.
2. Use the trackball to move the highlighted marker to the *maximum* IDd.

3. When the marker is in the desired position, press **F2** (**LV**) or the ☞ control. The other marker is now identified by two + hairline cursors.
4. Use the trackball to move the highlighted marker to the *minimum* IDd.
5. When the marker is in the desired position, press **F2** (**LV**) or the ☞ control. The *systolic* cursor is now highlighted.
6. Repeat steps 2 to 5 to measure the IDs.

To remove both cursors, press **F2** (**LV**) for more than one second.

Mitral Valve (MV) Study

The Mitral Valve study uses five markers (D, E, F, A and C) to calculate amplitudes (CE, DE, and CA), slopes (DE and EF) and the CA:CE ratio, see Fig. F6.

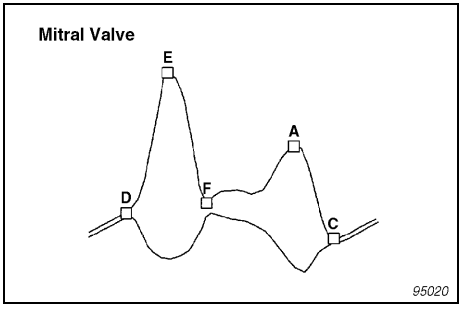


Fig. F6. Mitral Valve reference points

To start the study:

1. Press **F3** (**MV**) on the M Calc main menu (Fig. F4). The D marker will be identified and the letter D will be visible in the soft menu on the monitor.
2. Use the trackball to move the identified marker.
3. When the marker is in the desired position, press **F3** (**MV**) or ☞ . The E marker is now identified by a + cursor.
4. Repeat steps 2 and 3 until all five markers have been placed.

To reposition one of the markers, select it by pressing the ☞ control (or **F3**) to toggle between them. Use the trackball to move the marker.

To remove the markers, press **F3** (**MV**) on the M Calc main menu (Fig. F4) for more than one second.

Aortic Valve (AO) Study

The Aortic Valve study uses 4 pairs of markers to measure the right ventricular outflow tract diameter (RVOD), aortic root diameter (AOD), aortic valve diameter (AVD), left atrium diameter (LAD) and to calculate the LAD:AOD ratio (LAR).

To start the study, press **F4** (**AO**) on the M Calc Main menu (Fig. F4) to display the AV menu (Fig. F7).

RVOD‡	AOD ‡	AVD ‡	LAD ‡	
F1	F2	F3	F4	F5

Fig. F7. The AV menu

RVOD:

To measure RVOD:

1. Press **F1** (**RVOD**). Two markers appear on the monitor; one is identified by a number and a solid line.
2. Use the trackball to move the highlighted marker.
3. When the marker is in the desired position, press the ☞ control. The other marker is now identified.
4. Use the trackball to position the marker.

The measurement is now complete. To reposition one of the markers, select it by pressing the ☞ control to toggle between them. Use the trackball to move the marker.

After the distance has been measured, it is entered into the M Calc report automatically.

To delete the measurement, press **F1** for more than 1 second, or press the ✕ control while the measurement is selected.

Press ↶ to go back to the M Calc main menu.

AOD, AVD and LAD:

If the **RVOD** markers have been positioned and **F2** (**AOD**) on the AV menu (Fig. F7) is pressed, the AOD markers will be in line (vertically) with the RVOD markers.

To make similar measurements for the other parameters, press **F2** (**AOD**), **F3** (**AVD**) or **F4** (**LAD**) and follow the instructions for the RVOD measurement.

F.2 M-mode Reports

Displaying a Report

Press **F5** (**Report**) on the M Calc main menu to display a report on the monitor, and to display the Report menu shown in Fig. F8.

Height	Weight	Remark	Next Report	
F1	F2	F3	F4	F5

Fig. F8. The M Calc Report menu

Editing a Report

Note: If the height and weight of the patient have already been entered in the Cardiac Report menu, those values will be shown here.

Press **F1** (**Height** on the Report menu) and use the keyboard to type in the patient's height.

Press **F2** (**Weight**) and enter the patient's weight.

Press **F3** (**Remark**) to edit the Remark field of the report, then use the keyboard to type in the text.

Press **F4** (**Next Report**) to toggle through the four reports: Basic, LV, MV and AO.

Press ↶ to go back to the M Calc main menu.

Printing a Report

While the report is displayed on the monitor, press the control to print the report via a connected video printer.

Resetting

To reset the M Calc measurements (except the height and weight) and clear the report, press the **Car (**<R> on the keyboard**)** control for more than 1 second.

Section G

Cleaning, Disinfection and Storage

G.1 Cleaning **1**

Scanner Unit and Keyboard 1
Palm Control Unit (PCU) 2
Transducers and Puncture Attachments 2

G.2 Disinfection **2**

Scanner Unit and Keyboard 3
Palm Control Unit (PCU) 3
Summary of Disinfection/Sterilization Methods 5
Storage 5

G.3 Maintenance **6**

Scanner Maintenance 6
Palm Control Unit Maintenance 6
Transducer Maintenance 7

G.4 Disposal of the Scanner **7**

References 7

G

G.1 Cleaning

To ensure the best results when using B-K Medical equipment, it is important to maintain a strict regular cleaning routine.

WARNING

Users of this equipment have an obligation and responsibility to provide the highest degree of infection control possible to patients, co-workers and themselves. To avoid cross-contamination, follow all infection control policies for personnel and equipment that have been established for your office, department or hospital.

Caution:

Keep all plugs and sockets absolutely dry at all times.

Scanner Unit and Keyboard

Clean the scanner unit, front panel and keyboard after every examination using a soft cloth moistened with a mild detergent or a disinfectant. Wipe dry with a lint-free cloth.

You can remove the holders for transducers and scanning gel etc. from the front of the scanner to clean them.

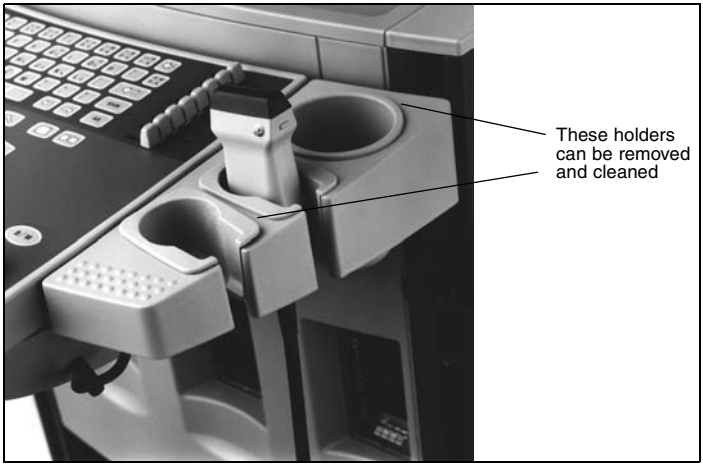


Fig. G1. Front panel showing transducer and gel holders

The trackball can also be removed for cleaning. See Section A.3 “The Front Panel Controls” for instructions on loosening the trackball using the trackball tool (QA0228).

Although the surface of the machine is resistant to many chemicals, avoid using strong chemicals as they can discolor it.

Palm Control Unit (PCU)

You must wear gloves during all stages of cleaning:

1. Ensure the PCU is at room temperature.
2. Remove the PCU’s CIV-Flex™ sheath.
3. Immediately rinse off any visible contamination (such as biological substances) with a detergent and tap water at a maximum temperature of 40° C (104° F), using a brush if necessary. Keep the bioburden* at a minimum.

Caution:
Keep all plugs and sockets absolutely dry at all times.

Transducers and Puncture Attachments

Please refer to the *Transducer Care, Cleaning & Safety* manual for instructions for cleaning transducers and puncture attachments.

G

G.2 Disinfection

A list of disinfectants that the scanner can withstand can be found in the Product Data sheet (BP0127) that accompanies this user guide. However, local government rules and guidelines for disinfecting ultrasound equipment should be followed at all times.

---

* The bioburden of used instruments varies. Data are scarce, but it is suggested there is a low bioburden after cleaning surgical instruments (98% of instruments have less than 10^2 living organisms after cleaning) [1].

Specifications for the scanner can be found in the Product Data sheet (BP0127) that accompanies this user guide.

Please refer to the *Transducer Care, Cleaning & Safety* manual for instructions for disinfecting transducers and puncture attachments.

Scanner Unit and Keyboard

The scanner unit and keyboard can be disinfected by wiping with a soft cloth moistened with a disinfectant. A list of disinfectants that can be withstood is given in the Product Data sheet (BP0127) that accompanies this user guide.

Palm Control Unit (PCU)

The PCU is a sealed unit and can be totally immersed.

Immersion

The PCU can be disinfected by immersion. In order that the PCU, including the plug, can be immersed, special water-tight plug covers have been provided (see Fig. G2 and Fig. G3).

These covers should be screwed tightly over the connector plug before immersion.

Fig. G2. PCU's plug with water-tight cover removed

See the *Transducer Care, Cleaning & Safety* manual for more information about disinfection using immersion.

Caution:

Before immersing, the water-tight plug cover must be screwed tightly on to the PCU's plug. If fluid comes into contact with the plug, the PCU may be destroyed.

Fig. G3. PCU's plug with water-tight cover screwed tightly on

STERRAD®

After the PCU has been cleaned as described in Section J.1, it can be processed using the STERRAD® System.

WARNING

Always follow the manufacturer's instructions for using the STERRAD® System.

Caution:

The watertight PCU plug cover MUST NOT be screwed on while the PCU undergoes the STERRAD® process.

Caution:

After each processing, you must check the PCU for surface pits and cracks.

STERIS SYSTEM 1®

After the PCU has been cleaned as described in Section J.1, it can be processed using STERIS SYSTEM 1®.

WARNING

Always follow the manufacturer's instructions for using the STERIS® System.

Caution:

The watertight PCU plug cover MUST be screwed on while the PCU undergoes the STERIS SYSTEM 1® process.

Ethylene Oxide Gas

After the PCU has been cleaned as described in Section J.1, it can be processed using ethylene oxide gas.

WARNING

When using ethylene oxide, always follow the manufacturer's directions for use and the instructions regarding personal protection.

Caution:

The watertight PCU plug cover MUST NOT be screwed on while the PCU is processed with ethylene oxide.

Summary of Disinfection/Sterilization Methods

Disinfection Method	Watertight Plug On/Off
Immersion	On
STERIS	On
STERRAD	Off
ETO	Off

Fig. G4. Methods for disinfection / sterilization of the PCU

WARNING

If there are any pits or cracks on the surface of the PCU, processing may not give a sterile product.

Storage

All B-K Medical ultrasound equipment should be stored in a cool, dry place and should never be exposed to temperatures below –25°C (–13°F) or above 60°C (140°F). Maximum storage humidity is 80% RH non-condensing. The operating atmospheric pressure should be between 700 and 1060hPa.

G.3 Maintenance

Scanner Maintenance

In order to ensure the stability and performance of the scanner, it is recommended that preventive maintenance should be performed once a year. This must be carried out by a B-K Medical technician or a suitably qualified engineer.

The preventive maintenance program consists of different areas and full detailed procedures can be found in the B-K Medical Service Manual (BI2101).

The areas covered are as follows:

User's Comments and Corrections
Faults observed by the user are dealt with.

Modifications to the System
In accordance with Service Information and Service Notes.

Mobility of the Scanner
To check mobility of the scanner.

Checking Procedure
To verify the correct operation of the main functions of the scanner.

Peripherals
To check the function of the peripherals.

Electrical Safety Test
To verify that the system complies with EN/IEC 60601-1 [2] or UL 2601-1 [3] or CSA C22.2 No. 601.1–M90 [4].

All the necessary equipment for carrying out preventative maintenance and the B-K Medical Service Manual (BI2101) can be obtained on request from B-K Medical.

Palm Control Unit Maintenance

The PCU's connector plug and the rubber ring on the plug should be thoroughly inspected before the PCU is used. If there are any changes in the color of the plug or the rubber ring, e.g. the

appearance of a grayish color, the unit must be checked by a B-K Medical service representative before using it.

The outside surface of the watertight plug cover may, after repeated disinfection, change color slightly. This does not represent any problem.

The PCU should also be checked by a B-K Medical service representative after every 150 times of disinfection.

Transducer Maintenance

See the *Transducer Care, Cleaning & Safety* manual for information about transducer maintenance.

G.4 Disposal of the Scanner

When the scanner is scrapped at the end of its life, national rules for the relevant material in each individual country must be followed. Within the EU, when you discard the scanner, you must send it to appropriate facilities for recovery and recycling.

The scanner contains many different materials, but none require any special treatment compared with what would normally be expected for materials used in electronic equipment.

It should, however, be noted that the printed circuit boards are made of epoxy, the monitor's picture tube contains heavy metals and the scanner contains a small lithium battery.

If further information is required about the material composition of the scanner, contact your B-K Medical service representative.

In general terms, disposal of the scanner should take place in such a way that nature and the environment are least affected.

References

[1] Nyström, B. Disinfection of surgical instruments. *Journal of Hospital Infection* 1981; 2:363-68.

[2] EN/IEC 60601-1:1990 +A1:1993+A2:1995+A13:1996 *Medical electrical equipment. Part 1: General requirements for safety.*

[3] UL 2601-1:2003 *Medical Electrical Equipment – Part 1. General Requirements for safety.*

[4] CSA C22.2 No. 601.1–M90:2001 *Medical Electrical Equipment – Part 1. General Requirements for safety.*

Section H

Installation

⚠ Installation of the scanner must only be carried out by a qualified engineer who is familiar with IEC 60601–1 (Medical Electrical Equipment) and applicable local safety regulations.

More comprehensive technical information is included in the separate service manual, which is available on request.

H.1 Introduction 1

H.2 Operating Environment 1

H.3 Mains Voltage 2

H.4 Fuses 3

H.5 Power Supply Cord 4

H.6 Cables Types and Lengths 4

H.7 Connecting Other Equipment 5

Auxiliary Power Outlets 5
Additional Protective Ground and Potential Equalization 6
Connecting a Shock Wave Device 6
RS232 Sockets 6

H.8 Documentation Trigger 7

H.9 Symbols used for Connections 8

H.10 Connecting Video Documentation Equipment 10

Typical setup of documentation equipment 12
S-VHS Sockets 12
RGBS Sockets 13
VGA Sockets 14

H.11 Foot Switch Socket 16

H.12 Configuration Switch 17

H.13 Connecting a Palm Control Unit 18

H.14 Adjusting the Shelf 20

Adjusting the Height 20
Adjusting the Depth 21
Adjusting the Angle 21

H.15 Tidying the Cables 21

H.16 Dismantling the Scanner for Transportation 23

Removing and Replacing the Monitor 23
Removing and Replacing the Monitor Base 24
Front Panel 25
Literature 27

H.1 Introduction

This chapter contains information about electrical requirements and operating conditions for the scanner as well as important information about attaching other equipment. Before you switch on the scanner, make sure that the installation has been approved by a qualified service technician or by hospital safety personnel.

H.2 Operating Environment

The scanner can be operated safely within the following operating condition limits:

Ambient operating temperature –10° to 40°C (50°F to 104°F).

- Humidity - max. 80% RH non-condensing.
- Atmospheric pressure - between 700 and 1060 hPa.

WARNING

Follow the guidelines in EN60601-1-1 [1] when you connect the scanner to other equipment. See "IEC and EC symbols on the scanner" in the introductory section of this user guide.

WARNING

During use, the scanner must be at least 25cm (10 inches) from the patient to minimize the risk of igniting explosive gases.

The scanner is not intended for use in potentially explosive environments and should be kept well away from flammable gases and liquids. It should not be used in oxygen-enriched atmospheres. Avoid excessive heat, dust and direct sunlight.

H.3 Mains Voltage

Before use, the **Mains Voltage Selector** on the back of the scanner (Fig. H1) must be set to match the voltage of the AC mains power supply being used. The scanner is able to operate in two different AC voltage ranges; from 100 – 120V and from 200 – 240V.

Fig. H1. The mains voltage selector

To change the mains voltage range, move the switches up or down until the appropriate voltage value is showing on both switches.

Caution:

The scanner is set up to operate in the 100-120V mains voltage range and it will be damaged if connected to 230V.

Caution:

Before using the scanner for the first time (and after adjusting the mains voltage selector), check that the installed fuses are appropriate for the mains supply voltage. See Section H.4 "Fuses" for details.

Caution:

Do not switch the scanner on and off repeatedly in quick succession. Doing so may damage the equipment.

WARNING

Turn off the scanner and unplug the power cord from the mains power supply (the wall outlet) before changing voltage or performing any repairs to the system.

H.4 Fuses

On delivery, the correct fuses for your mains voltage are installed in the scanner. When replacing fuses, ensure that the correct fuses are installed. Use only the fuses shown in Fig. H2.

Mains Voltage	Fuse Rating	Fuse Number
115V	T 8A H, 250V (Time-lag, high breaking capacity)	VF0099
230V	T 6.3A H, 250 V (Time-lag, high breaking capacity)	VF0093

Fig. H2. Fuse information

Before changing fuses, always turn off the scanner and disconnect it from the mains power supply.

The fuse holders are located on the rear panel (see Fig. H4). Pull out the small drawer containing the fuses, remove the fuses and replace with the appropriate type. Shut the fuse drawer firmly.

H.5 Power Supply Cord

The scanner is supplied with a power supply cord that is specific to your region.

WARNING

Use only the power supply cord that comes with the scanner. Never use extension cords. The increased length of the cord will increase the resistance of the protective ground conductor and may increase the equipment's leakage current beyond an acceptable level.

H.6 Cables Types and Lengths

Fig. H3 specifies the cables that were used to test the electromagnetic compatibility (EMC) of the scanner. EMC data for all transducers used with this scanner are on a CD (BZ2100) that accompanies this user guide.

To fulfill EMC requirements, do not attach cables to the scanner unless they are the same type as listed in the table and do not exceed the maximum length given in the table.

Connector	Part number	Type and Maximum Length
RGBS out	AO1381	Shielded, 2 m, ferrite
RGBS in	AO1381	Shielded, 2 m, ferrite
B/W Composite out	AO0142	Shielded, 3 m
B/W Composite in	AO0142	Shielded, 3 m
SVHS in	EL4003 (included in EU4009)	Shielded, 2 m
SVHS out	EL4003 (included in EU4009)	Shielded, 2 m
Phono out/in	EL4017 (included in EU4009)	Shielded, 2 m
Copy	EL4008 (included in EU4020)	Unshielded, 1 m

Fig. H3. List of cables used in testing for EMC compliance

H.7 Connecting Other Equipment

For important safety information about connecting other equipment, see “Connecting Other Equipment” in the first section of this user guide.

WARNING

When you connect other equipment that uses the line voltage (such as a video printer, video recorder or other documentation device) to the scanner, the connections must follow the guidelines given in EN 60601–1–1 [1]. If in doubt, contact your local B-K Medical representative.

Auxiliary Power Outlets

To minimize leakage currents, plug all other equipment into the isolated auxiliary power outlets on the rear panel of the scanner. There are three auxiliary power outlets and one main power input, see Fig. H4.

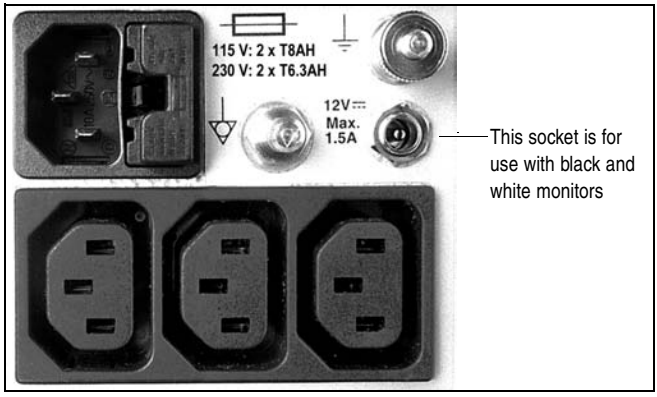


Fig. H4. The bottom right section of the back panel

The voltage of these outlets is the same as the voltage from the power supply cord. Circuit breakers (overload releases) limit the power that can be drawn from the outlets to a safe level. The total output must not exceed 300VA.

Additional Protective Ground and Potential Equalization

An additional ground can be connected to the ⏚ terminal, see Fig. H4.

The potential equalization terminal ⏚ is connected to the scanner chassis. It can be connected to corresponding terminals on other equipment to eliminate potential differences. Do NOT use it for safety grounding.

Connecting a Shock Wave Device

A shock wave device must **NOT** be connected to the auxiliary power outlets. If you are using the scanner with a shock wave device, make sure that the shock wave device complies with the guidelines in EN/IEC 60601-1 [2]. Connect both the scanner and the shock wave device directly to the line voltage.

It is important that you read the connecting instructions for the shock wave device system in the appropriate manufacturer's user guide.

RS232 Sockets

There are two RS232 sockets which are available to connect other equipment, e.g. a computer, shock wave device or PCU. The shock wave device should be attached to the RS232 A socket. The PCU should be attached to the RS232 B socket (see Section H.13 "Connecting a Palm Control Unit" for further details).

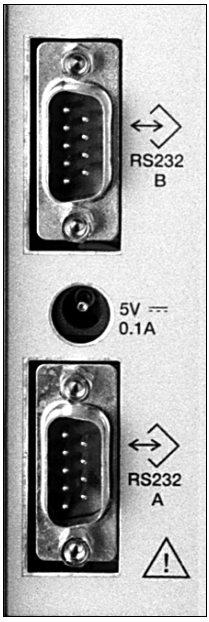


Fig. H5. RS232 sockets

H.8 Documentation Trigger

The **Documentation Trigger** socket (Fig. H6) on the scanner's rear panel permits control of selected documentation accessories.

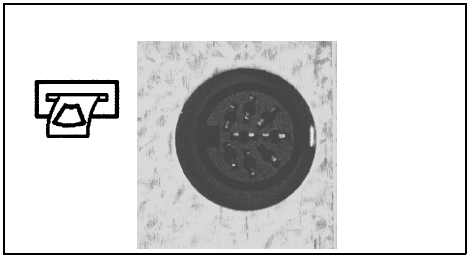


Fig. H6. The Documentation Trigger socket

The pin configuration is shown in Fig. H7.

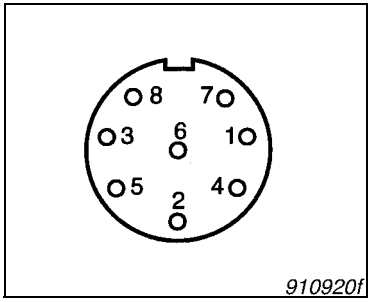


Fig. H7. Pin configuration of the Documentation Trigger socket (external view)

When the copy function is activated, the relay short-circuits pins 1, 5, 6 and 8 to pins 2, 3, 4 and 7.

Note: Maximum load on the relay must not exceed 10W, 100V and 0.5A.

B-K Medical copy cable EL4008 (part of the cable sets EU4020 and EU4021) connects the Documentation Trigger socket to the trigger input of a video printer. This enables the user to start the printer by pressing on the front panel or by pressing the transducer's built-in control button for more than 1 second.

B-K Medical video cassette recorder (VCR) interface kit (EU4015) connects the VCR to the documentation trigger socket and allows you to activate the "pause" function on the VCR by pressing on the front panel or by pressing the transducer's control button for more than 1 second.

H

H.9 Symbols used for Connections

The symbols used on the back panel and front of the scanner are described in Fig. H8.

Symbol	Description
	Composite Out B/W
	Composite Out Color
	Composite In Color
	Fuses
	Documentation trigger (Copy)
	RS232 connection
	Monitor
	Lightpen socket (lightpen UA1209 no longer available)
	Mechanical transducer socket
	Front panel cable socket
	Foot switch
	Audio
	S-VHS in
	S-VHS out
	RGBS out
	RGBS in

Fig. H8. Symbols used on the back and front of the scanner

H.10 Connecting Video Documentation Equipment

The video documentation sockets are shown in Fig. H9.

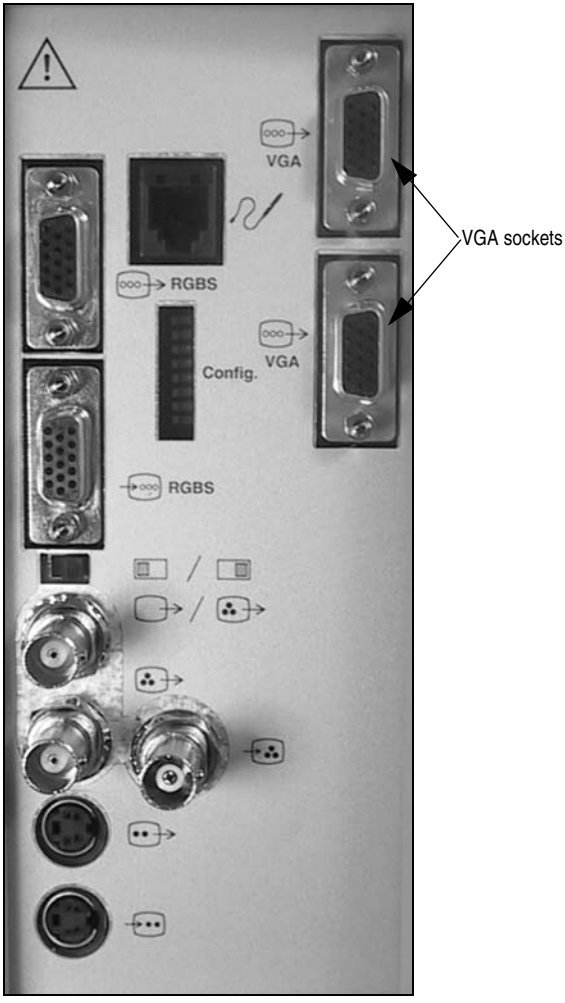


Fig. H9. The video documentation sockets

The symbols used on the back panel are shown in Fig. H8.

Standard video documentation equipment (e.g. a standard VCR) can be connected to the **Composite Out** socket. For playback from a standard VCR, the **Composite In** socket should be used.

A S-VHS video recorder can be connected to the **S-VHS Out** socket and can be played back through the **S-VHS In** socket.

The VCR can be toggled on and off by pressing <Alt><V>.

A color video printer or external monitor can be connected to the **RGBS out** socket. The signal level from the **R**, **G,** and **B** pins is 0.7Vpp/75Ω, and from the **S** pin is TTL level.

A black and white composite signal can be sent to an external black and white monitor. The monitor should be connected to the **Composite Out** socket.

Underneath the **RGBS In** socket, there is a switch that can be set to the right or the left. This determines the function of the CBVS socket underneath it. Set the switch to the left for **Composite B/W** and to the right for **Composite Color**.

Typical setup of documentation equipment

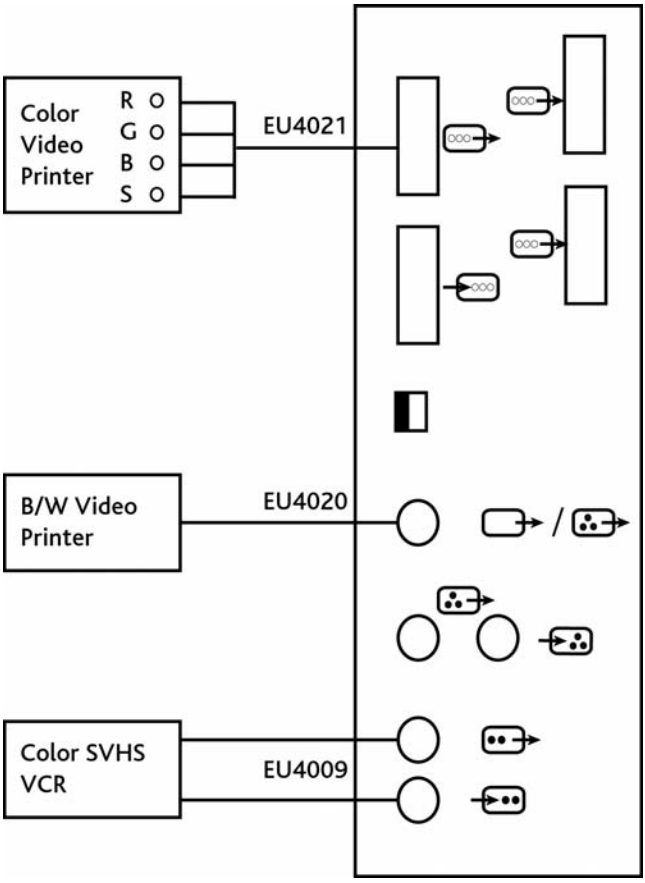


Fig. H10. Suggested setup for documentation equipment showing the required cable sets

The diagram in Fig. H10 shows a color video printer connected to the **RGBS out** socket with the b/w video printer connected to the **Composite out** socket (with switch set to the left) and the S-VHS VCR connected to the **S-VHS Out** and **In** sockets.

S-VHS Sockets

A S-VHS video recorder can be connected to the **S-VHS Out** socket and can be played back through the **S-VHS In** socket.

The pin configuration of the **S-VHS** sockets are shown in Fig. H11.

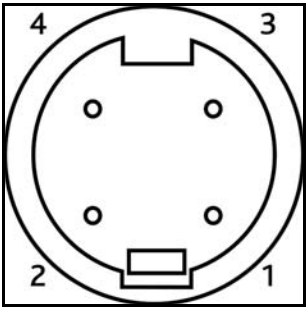


Fig. H11. Pin configuration of the S-VHS Sockets

For the **S-VHS** sockets, pin 3 is S-VHS (Y) and pin 4 is S-VHS (C). Pins 1 and 2 are earth connections.

RGBS Sockets

A color printer or external video monitor can be connected to the RGBS **Out** socket. The **RGBS In** socket can be connected to any other RGBS source e.g. camera.

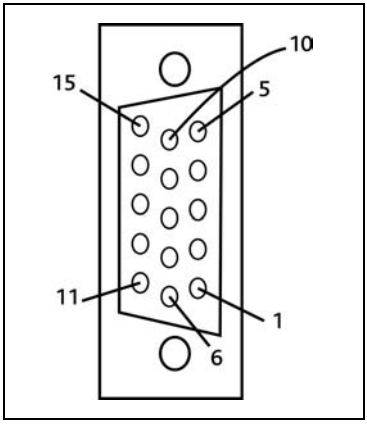


Fig. H12. Pin configuration of the RGBS socket showing row end pin numbers

Pin	Function
1	Red
2	Green
3	Blue
5	Ground
13	Synchronization

Fig. H13. Pin definitions of the RGBS In socket

Pin	Function
1,11	Red
2, 4	Green
3,12	Blue
5,6, 7,8,10	Ground
13, 15	Synchronization

Fig. H14. Pin definitions of the RGBS Out socket

Note: Only one piece of external equipment can be connected to the **RGBS Out** socket.

VGA Sockets

The scanner's monitor is connected to one of the **VGA** sockets See Fig. H9. A projector, external PC monitor or another piece of equipment with an analog RGB non-interlaced output, can be connected to the second **VGA** socket.

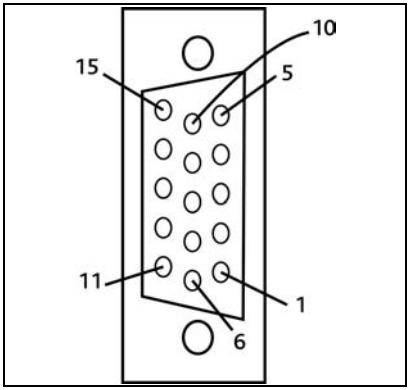


Fig. H15. Pin configuration of the VGA sockets

Pin definitions for these sockets are given in Fig. H16.

Pin	Function
1	Red
2	Green
3	Blue
5	Ground
13, 14	Synchronization

Fig. H16. Pin definitions of the VGA sockets

H.11 Foot Switch Socket

This socket is for the connection of the optional foot switch.

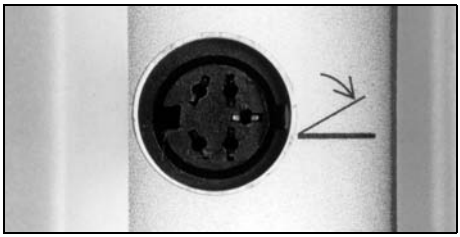


Fig. H17. Foot switch socket

The pin configuration of this socket is as follows:

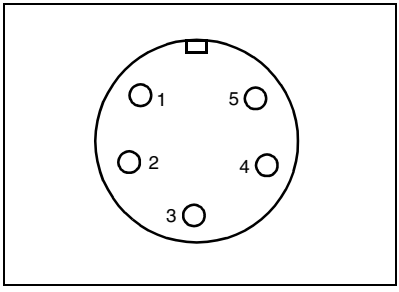


Fig. H18. Pin configuration of the foot switch socket

Pin	Use
1,2	Right switch
3	Reserved
4,5	Left switch

Fig. H19. Pin definitions of the foot switch socket

H.12 Configuration Switch

The **Config.** switch (see Fig. H20) lets you select the language for the monitor display, a TV standard and the RS232 channel setting.

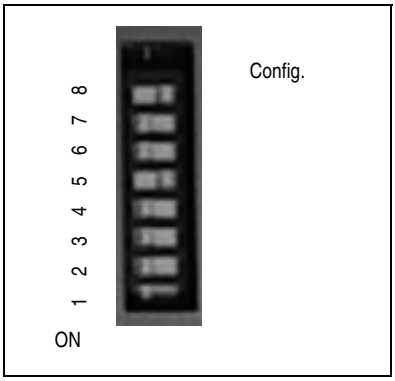


Fig. H20. The Config. switch

WARNING

Turn off the scanner and unplug the power cord from the mains power supply (the wall outlet) before changing the switch settings or performing any repairs to the system.

Switch 1 lets you select the language. To be able to select a language, set the switch to the left (default setting). See Section A.2 “Customizing Your System” for more information on language selection. To set the language to English only, move the switch to the right.

Switch 2 lets you select the RS232 A mode. Move the switch to the right for enhanced mode and left for standard. If you are using a shock wave device in the RS232A socket the switch must be set to the right.

Switch 3 lets you select the TV standard. To select the 60Hz (NTSC) standard, set the switch to the right. To select the 50Hz (PAL) standard, set the switch to the left.

Switches 4 to 8 are for B-K Medical use. They must be set to the left.

The selected switch settings will become operational after switching off and then re-booting the scanner.

H.13 Connecting a Palm Control Unit

WARNING

Make sure that the PCU is labeled UA1270. If you use a different model of PCU, pressing the keys will not have the function you expect.

To connect a Palm Control Unit (PCU) to the scanner, it must first be connected to adaptor UA1271 (see Fig. H21).

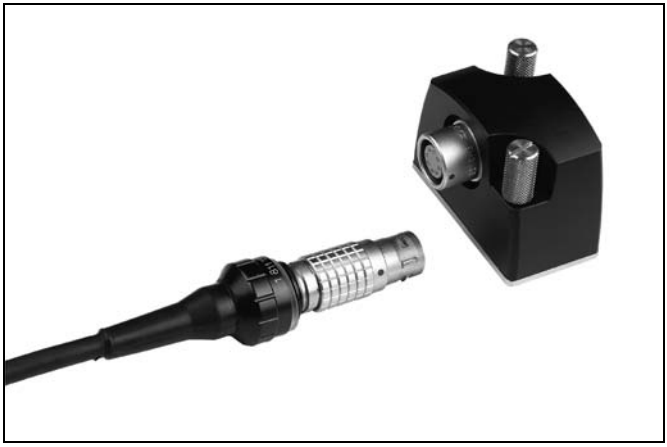


Fig. H21. Palm Control Unit plug and adaptor UA1271

Connect the PCU to the adaptor, ensuring that the two dots are lined up (see Fig. H22).

Fig. H22. Palm Control Unit connected to adaptor UA1271

The adaptor connects to the RS232 B socket on the special rear panel of the scanner, designed for use with the PCU (see Fig. H23).

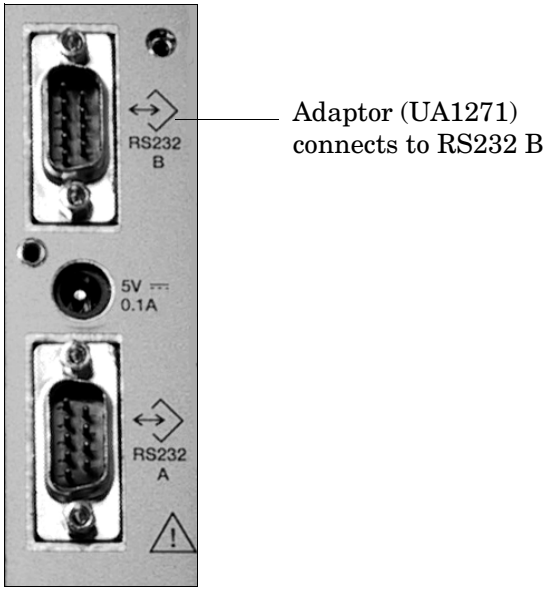


Fig. H23. RS232 sockets on the special rear panel of scanner

Caution:

A specially-designed rear panel is required to connect adaptor UA1271 to the scanner. The rear panel is included as part of the Palm Control Unit kit (UA1270-K). Contact your local B-K Medical representative for further information.

Note: The PCU should not be used, in particular the mouse stick should not be touched, for 12 seconds after the scanner has been turned on. This is to allow time for the PCU setup.

H.14 Adjusting the Shelf

A shelf to hold documentation accessories is provided with the scanner. This shelf can be set at different heights and angles and moved forwards or backwards to ensure that your documentation equipment can be accommodated.

Fig. H24. Shelf, fixing bracket and tool

Adjusting the Height

There are four holes in the scanner's legs which allows the shelf to be placed at different heights. The shelf is fixed by using the mounting bracket and screws. Fig. H24 shows the bracket with

holes and the shelf. A further choice of heights is obtained by using the bracket the other way up.

Adjusting the Depth

There are three holes on each side of the shelf which allow two different depth positions.

Adjusting the Angle

In some circumstances it may be helpful to set the shelf at an angle to accommodate the documentation equipment. The bracket has double holes on the top of the face to allow the shelf to be placed at an angle. A further choice of angles can be obtained by using the bracket the other way up.

H.15 Tidying the Cables

To keep the cables on the back of the scanner tidy and together, two cable spirals are available. These can be opened and the cable threaded through and then fixed into the grooves on the legs of the scanner. There are 2 grooves on the back, 2 on the front and 1 on each side.

Fig. H25. Rear side view showing the cable spiral in the groove

Any excess cable length can be accommodated in the cable shelf. The cable shelf is located under the back panel.

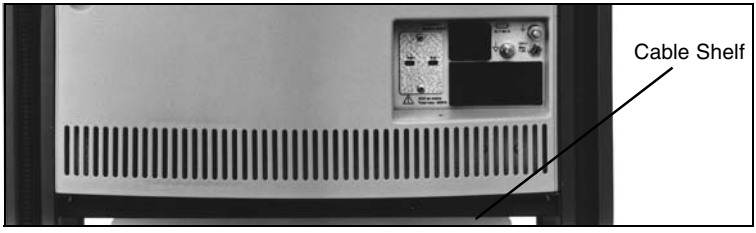


Fig. H26. Back panel showing the shelf for excess cable

H.16 Dismantling the Scanner for Transportation

The front panel, monitor and monitor base can be removed to make it easier to transport the scanner (see Fig. H30).

Removing and Replacing the Monitor

To Remove the LCD Flat Screen Monitor From the Base:

1. Make sure that the scanner wheels are locked.
2. Unplug the power cable and VGA connector from the back of the monitor.
3. Loosen the 2 thumb screws on the bracket to expose approximately 5 mm of thread. If metal screws have replaced the thumb screws (in order to secure the flat screen monitor from theft), use an Allan key to loosen these screws.
4. Slide the monitor off the base.

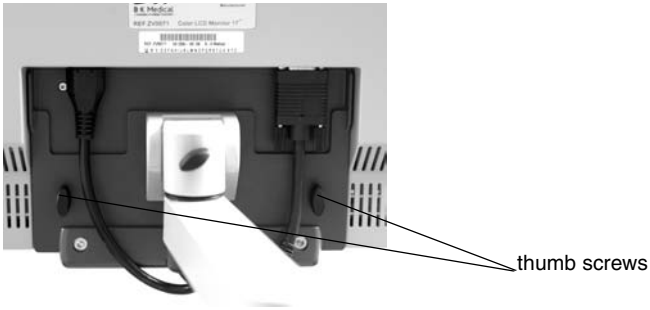


Fig. H27. Loosen the thumb screws to remove the monitor from the base

To Replace the LCD Flat Screen Monitor:

1. Make sure that the scanner wheels are locked and that the sliding covers are removed.
2. Make sure that the two thumb screws on the bracket are loosened exposing approximately 5 mm of thread.

3. Slide the monitor onto the base, making sure that it is securely and completely on the base and is not crooked.
4. Tighten the thumb screws until the flat screen is secured, or tighten the metal screws using an Allan key.

WARNING

If the thumb screws are not tightened correctly so that they secure the monitor, the monitor can fall off and injure you or others when you move the scanner.

5. Plug the power cable and VGA connector into the back of the monitor.

Removing and Replacing the Monitor Base

To Remove the Monitor Base:

1. Make sure that the scanner wheels are locked.
2. Take off the cable spirals holding the cables (see Fig. H25).
3. Disconnect 2 monitor connections on the rear panel of the scanner: the VGA connector and the power cable (see Fig. H9).
4. Remove the 2 sliding covers from the scanner (see Fig. H29).
5. Loosen the two black screws (see Fig. H29) on the back of the scanner under the monitor. (Do not remove them.)
6. Lift the monitor base carefully out of the grooves.

To Replace the Monitor Base:

1. Make sure that the scanner wheels are locked.
2. Make sure that the lock pin in the stop bracket is in the middle position, see Fig. H29.

Caution:

It is important that the lock pin is in the middle position. This prevents the monitor and front panel from slipping downwards and damaging the connectors etc.

3. Remove the 2 sliding covers from the scanner (see Fig. H29).
4. Slide the monitor base into the grooves until it is at the height you want.

5. Tighten the black screws.
6. Replace the sliding covers.
7. Reconnect the monitor and base to the scanner.

Fig. H28. Removing the keyboard prior to front panel removal

Front Panel

To Remove the Front Panel:

1. Disconnect the front panel from the scanner.
2. Remove the sliding cover (see Fig. H29).
3. Undo the black screws under each side of the front panel.
4. Lift the front panel out of the groove.
5. Replace the sliding cover.

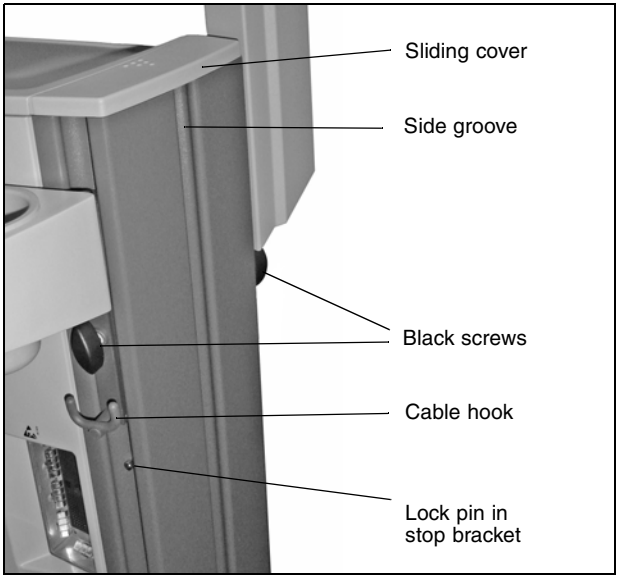


Fig. H29. Side view of 2101EXL

To Replace the Front Panel:

1. Remove the sliding cover.
2. Ensure that the lock pin in the stop bracket is in the middle position (see Fig. H29).
3. Slide the front panel back into the groove to the required height.
4. Tighten the black screws.
5. Reconnect to the scanner.

Fig. H30. The process of dismantling the scanner for transportation

Literature

[1] EN 60601–1–1:2001 *Medical electrical equipment – Part 1-1: General requirements for safety. Collateral standard: Safety requirements for medical electrical systems.*

[2] EN/IEC 60601–1:1990+A1:1993+A2:1995+A13:1996 *Medical electrical equipment. Part 1: General requirements for safety.*

Appendices

Appendix 1. Keyboard Shortcuts and Functions 1

Keyboard Shortcuts 1
Keyboard Functions 2
User-Defined Shortcut keys 2
International Characters 4
Palm Control Unit 5

Appendix 2. Setup Overview 6

Appendix 3. Urology Calculation Methods 9

General Information 9
HWL 9
Planimetry 10
Automatic Planimetry 10
Empirical Method 11
PSA Density 12
Accuracy of Calculations 12
References 14

Appendix 4. Cardiac Calculation Methods 15

Using B-mode 15
Using M-mode (Teichholz Method) 16
Accuracy of Calculations 17
Accuracy of M-mode Calculations 19
References 19

Appendix 5. Obstetrics Calculation Methods 20

General Information 20
Hansmann 21
Tokyo 24
Robinson 25
Kurtz 26
Hobbins 26
Hadlock 28
Campbell 31
Hellman 33
Jeanty 33
Eik-Nes 35
Williams 35
Persson 36
Osaka 36
Shepard 37
Warsof 37
Accuracy of Calculations 37
References 38

Appendix 1. Keyboard Shortcuts and Functions

Keyboard Shortcuts

Some soft menu functions can be accessed using keyboard shortcuts, as listed in Fig. 1.1.

Function	Key combination	Action
Image Right	<Alt><→>	Toggle image right
Image Left	<Alt><←>	Toggle image left
Image Up	<Alt><↑>	Toggle image up
Image Down	<Alt><↓>	Toggle image down
Rotation axis	<Shift><Alt><R>	Toggles rotation axis on/off
Edit OB Report	<Shift><Alt><E>	Remove data from OB report

Fig. 1.1. Keyboard shortcuts

Fig. 1.2 shows predefined keyboard shortcuts that can be used when the keyboard is not in use for another function.

Function	Key combination	Action
Basic Calc	<Q>	Selects the Basic Calculation menu
Uro Calc	<W>	Selects the Urology Calculation menu
Ob Calc	<E>	Selects the OB Calculation menu
Car Calc	<R>	Selects the Cardiac Calculation menu
HR	<S>	Activates the HR menu
Sim	<N>	Allows simultaneous T and S scanning with 8808
VCR	<V>	Toggles the VCR playback function on and off

Fig. 1.2. Keyboard shortcuts when the keyboard is not being used for another function

Keyboard Functions

The functions in Fig. 1.3 can only be accessed using the keyboard combinations listed in the table.

Function	Key combination	Action
Gray scale bar for screen adjustment	<Shift><Alt><G>	Places gray scale bar on the monitor for use during screen adjustment
Label	<Shift><Alt><**ABC**>	Resets label library texts to the factory settings
Bodymark	<Shift><Alt><⟨⟩>	Resets bodymarks to the factory settings
Scanner ID	<Shift><Alt><ID>	Displays the ID/type of the scanner
Perineal puncture line	<Shift><Alt><P>	Places a perineal puncture line on the monitor
VCR input on/off	<Alt><V>	Toggles the VCR playback on/off
Arrow Up/Left	<Alt><H>	Displays left or right arrow pointing up/left in user-defined text
Arrow Up/Right	<Alt><J>	Displays left or right arrow pointing up/right in user-defined text
Arrow Down/Left	<Alt><K>	Displays left or right arrow pointing down/left in user-defined text
Arrow Down/Right	<Alt><L>	Displays left or right arrow pointing down/right in user-defined text

Fig. 1.3. Keyboard functions

User-Defined Shortcut keys

It is possible to define your own shortcut keys. To select the shortcuts, press **Setup** on the front panel. See Section A.2 “Customizing Your System” for detailed instructions. Fig. 1.4 and Fig. 1.5 show the OB and urology parameters for which you can define your own shortcut keys.

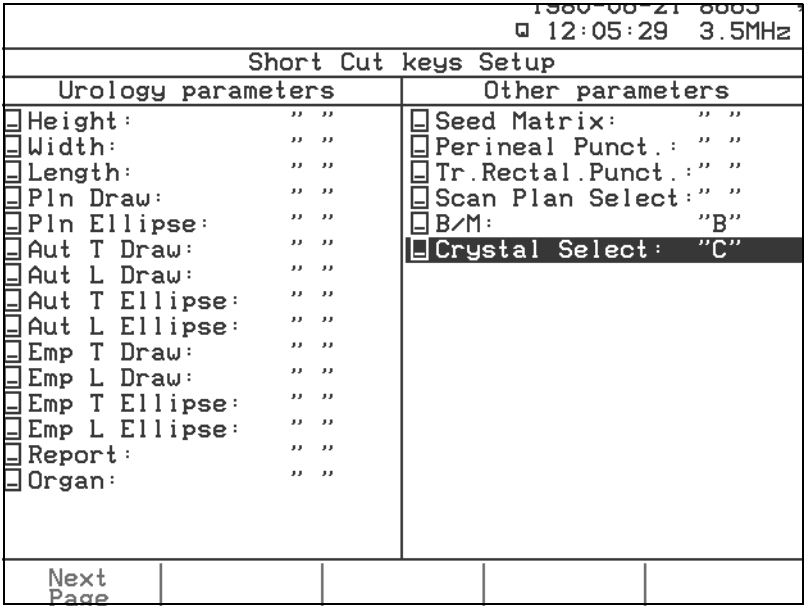


Fig. 1.4. Shortcut Keys Setup page for OB parameters

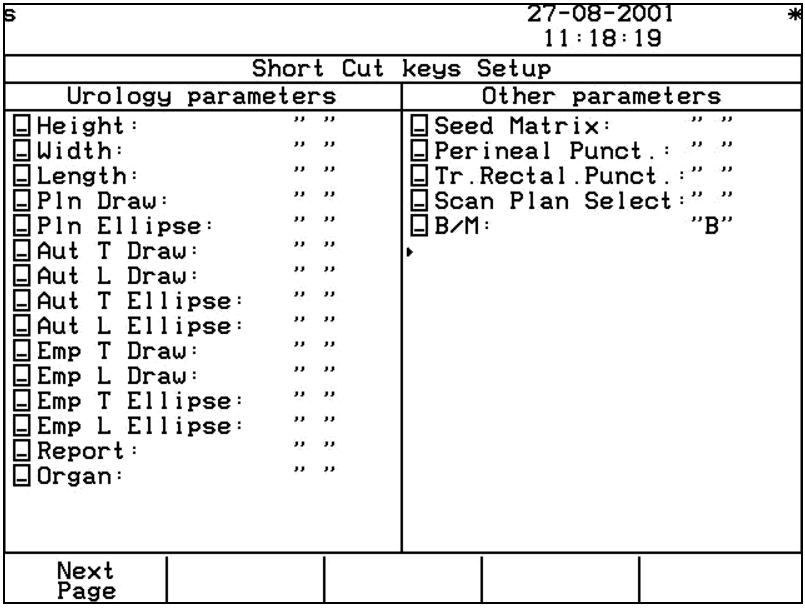


Fig. 1.5. Urology and Other Parameters Shortcut Keys setup page

International Characters

Special characters which are used for German, French, Swedish, Danish and Norwegian are accessed via keyboard combinations using the <Shift>, <Alt> and <Shift>+<Alt> keys.

They are listed in Fig. 1.6

Character	Key Combination	Character	Key Combination
ä	<Alt><5>	è	<Shift><8>
Ä	<Alt><Shift><5>	ê	<Alt><6>
ö	<Alt><O>	ë	<Alt><Shift><6>
Ö	<Alt><Shift><O>	ù	<Alt><Shift><8>
ü	<Alt><U>	æ	<Alt><9>
Ü	<Alt><Shift><U>	Æ	<Alt><Shift><9>
ß	<Shift><4>	ø	<Alt><0>
à	<Alt><8>	Ø	<Alt><Shift><0>
ç	<Alt><7>	å	<Alt><->
é	<Shift><6>	Å	<Alt><Shift><->

Fig. 1.6. International characters and their shortcut keys

Palm Control Unit

Fig. 1.7 shows the functions accessed using the Palm Control Unit

Control Key	Action/Function
Appl	Choose transducer application
	Increase size
	Decrease size
	Increase gain
	Decrease gain
	Freeze
	This control is inactive
	Distance markers activated
	Toggle image orientation left/right
	Select transducer
CFM Power	This control is inactive
Duplex Triplex	This control is inactive
B	B-mode
	This control is inactive
	This control is inactive
	This control is inactive
	This control is inactive
	This control is inactive
	Places a pointer on the monitor
	Activates default puncture guide

Fig. 1.7. PCU controls

Appendix 2. Setup Overview

Fig. 2.1 gives an overview of system setups, whether or not they are saved, and how they are saved.

- "Kept during power off" means that when you switch on the scanner, this setup will be set to the value it had when the scanner was last switched off.
- "Changeable parameters" means that these parameters can be changed from the system setup menus.

To find information on a specific setup, locate it in Fig. 2.1, then look at which column has a check mark.

Setup	Kept during power off	Changeable parameters (system setup)
Auto measure	✔	✔
Body-mark content	✔	
Body-mark setup	✔	
Composite Focus state and position		
Contour level		
Contrast level		
Date Format	✔	✔
D-Calc setup	✔	
Default body-mark library		
Default label library		
Displayed body mark		
Distance measure line type	✔	✔
Factor in Basic HWL calculation	✔	
Frame rate (Mech. Transducers)		
Gray scale in B+M modes		
Horizontal/Vertical split screen		
Hospital ID	✔	✔
HR cycle number	✔	✔
Image review duration		
Initial biplane		✔
Label content	✔	
Label texts and headlines	✔	
Language	✔	✔
Matrix spacing and offset	✔	✔
Measure button function		
Menu timeout		✔
OB method setup	✔	

Setup	Kept during power off	Changeable parameters (system setup)
Overall gain in B+M modes		
Probe saver	✔	✔
PSA constant	✔	
Puncture guide selected		
Rotation axis, Left/Right, Up/Down		
Screen saver	✔	✔
Shortcuts	✔	
Show image data	✔	✔
Size		
Strong Focus state and position		
Sweep speed in M-mode		
TGC Gain		
Test oscillators	✔	
TGC settings saved with transducer application	✔	✔
Thermal index settings		
Time Format	✔	✔
Transducer application	✔	
Transducer frequency selected (MFI)		
Transducer head/catheter selected (1850/1880)	✔	
Urology organ	✔	
Urology step size	✔	
Zoom		
Zoom Initial Mode	✔	✔

Fig. 2.1. Setup overview

Appendix 3. Urology Calculation Methods

General Information

The following methods for estimating volume are available:

- Height × Width × Length (HWL)
- Planimetry
- Automatic planimetry
- Empirical method (valid only for the bladder).

In addition, the system supports a method for calculating PSA (Prostate Specific Antigen) density.

This Appendix contains a general description of the calculation methods and the formulas used in these methods. Instructions for volume measurements are given in Section C.1 “Urology Measurements”.

HWL

This volume calculation is made by measuring the height, width and length of the organ or lesion. These measurements must be made at right angles to each other. Once these three parameters have been entered, the system automatically estimates the volume based on the formula:

Volume = H x W x L x Factor

Organ	Factor
Kidney	0.523
Testes	0.523
Prostate	0.523
Adenoma	0.523
Bladder	0.570

Fig. 3.1. The factors for different organs

The factor for kidney, testes, prostate, and adenoma and none implies that the organs have a true ellipsoid shape. However, for

the bladder the factor 0.57 is found to be more precise [1]. The factors are shown in Fig. 3.1.

Two methods for planimetry calculations are available: planimetry and automatic planimetry.

Planimetry

For this method, a number of parallel B-mode images are recorded which cover the structure of interest. The structure is outlined in each image. The system then estimates the volume of the structure based on these parallel sections. This method was analyzed in a study by Littrup et al [2] of 20 in vitro models and 100 patients. They found it to be an accurate technique for measuring prostate volume. The formula used for this calculation is:

$$Volume = \sum_{i=2}^{N} \frac{1}{3}(PA(i) + PA(i-1) + \sqrt{PA(i) \cdot PA(i-1)}) \cdot Stepsize$$

PA	Area of the recorded parallel section
Stepsize	Distance between parallel sections

Fig. 3.2. Definitions used in the manual planimetry formula

Automatic Planimetry

This method estimates volume by automatically performing simulated planimetry. The estimation is based on the convex outlines of two orthogonal sections, transverse and longitudinal. It is assumed that the shape of the transverse area outline represents the shape of any transverse area in the organ (see Fig. 3.3). The longitudinal outline must be the largest area that can be seen, and these measurements must be made at right angles to each other and to the transducer axis, and from the same transducer position.

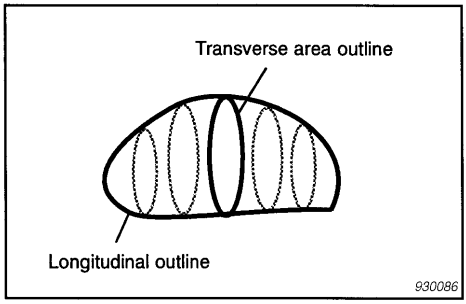


Fig. 3.3. The shape of the transverse area outline represents the shape of any transverse area in the organ

The formula used for this calculation is:

$$Volume = \frac{AreaT \cdot StepsizeAut}{3 \cdot Refwidth^2} \sum_{i=1}^{N} width(i)^2 + width(i-1)^2 + (width(i) \cdot width(i-1))$$

AreaT	Area of convex outline of transverse section
Refwidth	Maximum width of convex outline of transverse section parallel to transducer axis
width (i)	i'th width of convex outline of longitudinal section parallel to transducer axis
StepsizeAut	Distance between width measurement on convex outline of longitudinal section perpendicular to transducer axis. Set by system for optimal performance.

Fig. 3.4. Definitions used in the automatic planimetry formula

Empirical Method

This method is similar to automatic planimetry in that it is based on the outlines of two orthogonal sections: transverse and longitudinal. The outlines must represent the maximum areas of the bladder in the transverse plane (AT) and longitudinal plane (AL). The formula used for this calculation is:

$$Volume = exp(FactorBladderEmp1 + FactorBladderEmp2 \cdot ln(min(AL, AT)) + FactorBladderEmp3 \cdot ln(max(AL, AT)))$$

FactorBladderEmp 1	0.8304
FactorBladderEmp 2	0.5635
FactorBladderEmp 3	0.7211

Fig. 3.5. Factors used in empirical method formula

This formula is based on research by Rageth and Langer [3], in which they applied the empirical method in more than 200 cases studied. They found this approach to be a suitable method for routine clinical practice.

PSA Density

For this calculation, the PSA (Prostate Specific Antigen) level is divided by the volume of the prostate (using HWL volume). This method is discussed in an article by Benson et al [4] in which the method was used in a study of over 500 patients. The formula used for calculation of PSA density is:

$$Density = \frac{PSA\ level}{Prostate\ Volume} \cdot constant$$

The value of the constant depends on the method used for the PSA level measurement. The factory default is 1.00.

Accuracy of Calculations

Factors Affecting Accuracy

The input parameters used in the urology calculations are areas, distances and entered values. The measured parameters are used for calculating the volume of the organs with the following 4 methods:

- HWL
- Manual Planimetry (PLN)
- Automatic Planimetry (AUT)
- Empirical Method (EMP).

The calculation accuracy is influenced by a number of factors:

- the accuracy of the measured input parameters (see "Clinical Measurements: Ranges and Accuracies" on page xvii).
- the accuracy of the estimation methods
- the accuracy of the calculations.

The error introduced in the calculations by finite resolution of the floating point numbers is insignificant compared to that introduced by the other factors listed above. Hence, it will not be taken into consideration.

Formulas given here are to be used as a **guide** in the evaluation of the total expected accuracy for the calculation methods. In the formulas, A = accuracy.

Accuracy of HWL Calculation

Given the formula used for volume calculation, the accuracy of the method is:

$A(HWL) = A(H) + A(W) + A(L) = 3 \times A(\text{B-mode distance})$

Accuracy of AUT Calculation

Based on the assumption that both of the area measurements will be made on the same equipment:

$A(AUT) = A(\text{B-mode distance}) + A(\text{area})$

The accuracy of clinical planimetry measurements on the prostate was found to be ±7% with 95% confidence interval [2].

Note: This method should only be used on organs which are approximately "cigar" shaped.

Accuracy PLN

The comments and calculations given in the AUT calculation method section also apply for PLN.

Accuracy EMP

This **only** applies when the method is used for measuring the bladder. The accuracy is found to be less than 15% on average [3].

Accuracy PSAD

Given the formula used for calculation of the PSAD level, the accuracy of the method is:

$A(PSAD) = A(\text{area}) = 4\%$.

The method is described in [1].

References

[1] Brunn J, Ruf G. Sonografische Zystometrie. Deutsche Med, 105:1507-1503, 1980.

[2] Littrup PJ, Williams CR, Egglin TK, Kane RA. Determination of prostate volume with transrectal US for cancer screening. Part II. Accuracy of in vitro and in vivo techniques. Radiology, 179:49-53, 1991.

[3] Rageth JC and Langer K. Ultrasonic assessment of residual urine volume. Urological Research, 10:57-60, 1982.

[4] Benson MC, Whang IS, Olsson CA, McMahon DJ, Cooner WH. The use of prostate specific antigen density to enhance the predictive value of intermediate levels of serum prostate specific antigen. The Journal of Urology, Vol. 147, 817-821, March 1992.

Appendix 4. Cardiac Calculation Methods

General Information

The Cardiac Calculation Method is used to make measurements during cardiac examinations and (based on these measurements) calculations are made automatically.

The scanning modes that can be used are B-mode and M-mode. All the formulas for the cardiac calculations are listed in this appendix.

Connect an external video printer (EQ 4041), display the report on the monitor and press the control to print the report.

Using B-mode

End-diastolic Volume (EdV) in ml:

$$EdV = \frac{8}{3\pi} \times \frac{EdA^2}{EdL}$$ From reference [5]

where *EdA* is the end-diastolic area in cm^2 and *EdL* is the end-diastolic long axis in cm.

End-systolic Volume (EsV) in ml:

$$EsV = \frac{8}{3\pi} \times \frac{EsA^2}{EsL}$$ From reference [5]

where *EsA* is the end-systolic area in cm^2 and *EsL* is the end-systolic long axis in cm.

Stroke Volume (SV) in ml:

$$SV = EdV - EsV$$ From reference [6]

Cardiac Output (CO) in l/min:

$$CO = SV \times HR \times 10^{-3}$$ From reference [6]

where *HR* is the heart rate in beats/minute.

Heart Rate (HR) per minute:

$$HR = \frac{\text{Number of Cycles} \times 60}{\left| t_{ED} - t_{SS} \right|}$$

Ejection Fraction (EF):

$$EF = \frac{SV}{EdV}$$ From reference [7]

Stroke Volume Index (Si):

$$SI = \frac{SV}{BSA}$$ From reference [8]

Cardiac Output Index (Ci):

$$CI = \frac{CO}{BSA}$$ From reference [9]

Body Surface Area (BSA) in m²:

$$BSA = HT^{0,725} \times WT^{0,425} \times 0,007184$$ From reference [9]

where the *HT* is the height in cm and the *WT* is the weight in kg.

Using M-mode (Teichholz Method)

End-diastolic Volume (EdV) in ml:

$$EdV = \frac{7 \times IDd^3}{2,4 + IDd}$$ From reference [7]

where *IDd* is the left ventricle internal diameter at end-diastole in cm.

End-systolic Volume (EsV) in ml:

$$EsV = \frac{7 \times IDs^3}{2,4 + IDs}$$ From reference [7]

where *IDs* is the left ventricle internal diameter at end-systole in cm.

Stroke Volume (SV) in ml:

$$SV = EdV - EsV$$ From reference [6]

Cardiac Output (CO) in l/min:

$$CO = SV \times HR \times 10^{-3}$$ From reference [6]

where *HR* is heart rate in beats/minute.

Ejection Fraction (EF):

$$EF = \frac{SV}{EdV}$$ From reference [7]

Fractional Shortening (FS):

$$FS = \frac{IDd - IDs}{IDd}$$ From reference [7]

Stroke Volume Index (Si):

$$SI = \frac{SV}{BSA}$$ From reference [8]

Cardiac Output Index(Ci):

$$CI = \frac{CO}{BSA}$$ From reference [9]

Body Surface Area (Bsa) in m^2:

$$BSA = HT^{0,725} \times WT^{0,425} \times 0{,}007184$$ From reference [9]

where HT is the height in cm and WT is the weight in kg.

Left Atrial/Aortic Ratio:

$$LAR = \frac{LAD}{AOD}$$ From reference [10]

where LAD is the left atrium diameter in mm and AOD is the aortic root diameter in mm.

Accuracy of Calculations

Factors Affecting Accuracy

The accuracy of the calculation is influenced by:

- The accuracy of the measured input parameter for each transducer (see the Technical Data CD (BZ2100) that accompanies this user guide).
- The accuracy of the empirically determined equations.
- Rounding errors.

Accuracy in the Cardiac Calculations

The accuracy of the distance and area measurements is stated for each transducer on the Technical Data CD (BZ2100); these figures are used in the Cardiac calculations.

The error introduced in the calculations by finite resolution of the floating point numbers is insignificant compared to that introduced by the other factors listed above. Hence, it will not be taken into consideration.

Formulas given here to **guide** in the evaluation of the total expected accuracy for the calculation methods. In the following formulas, A = accuracy.

Accuracy of End-diastolic Volume (EdV)

$$A(EdV) = 2 \times A(\text{area}) + A(\text{distance})$$

Accuracy of End-systolic Volume (EsV)

$$A(EsV) = A(EdV)$$

Accuracy of Stroke Volume (SV)

$$A(SV) = \frac{(SV_{max} - SV_{min})}{SV} \quad \text{where}$$

$$SV_{max} = (EdV_{max} - EsV_{min})$$

$$SV_{min} = (EdV_{min} - EsV_{max})$$

Accuracy of Heart Rate (HR)

$$A(HR) = A(time)$$

Accuracy of Cardiac Output (CO)

$$A(CO) = A(SV) + A(HR)$$

Accuracy of Ejection Fraction (EF)

$$A(EF) = \frac{(EF_{max} - EF_{min})}{EF} \quad \text{where}$$

$$EF_{max} = \frac{(EdV_{max} - EsV_{min})}{EdV_{max}}$$

$$EF_{min} = \frac{(EdV_{min} - EsV_{max})}{EdV_{min}}$$

Accuracy of Stroke Volume Index (SI)

$$A(SI) = A(SV) + A(BSA)$$

Accuracy of Cardiac Output Index (CI)

$$A(CI) = A(CO) + A(BSA)$$

Accuracy of Body Surface Area (BSA)

$$A(BSA) = 0{,}725 \times A(HT) + 0{,}425 \times A(WT)$$

Accuracy of Height (HT)

$$A(HT) = 0{,}5\%$$

Accuracy of Weight (WT)

$$A(WT) = 1\%$$

Accuracy of M-mode Calculations

The M-mode calculation accuracies are the same as the cardiac calculations except the following:

Accuracy of End-diastolic Volume (EdV)

$$A(EdV) = A(EsV) = 2 \times A(\text{distance})$$

Accuracy of Fractional Shortening (FS)

$$A(FS) = \frac{(FS_{max} - FS_{min})}{FS} \quad \text{where}$$

$$FS_{max} = \frac{(IDd_{max} - IDs_{min})}{IDd_{max}}$$

$$FS_{min} = \frac{(IDd_{min} - IDs_{max})}{IDd_{min}}$$

Accuracy of Aortic Valve Study

$$A(LAR) = 2 \times A(\text{distance})$$

References

[5] Green DG, Carlisle R, Grant C, Bunnell IL. Estimation of left ventricular volume by one plane cineangiography. Circulation 1967; 35:61.

[6] Pai AL, Cahill NS, DuBroft RJ, Fozzard HA, Brooks HL. Digital computer analysis of M-scan echocardiograms. J. Clin. Ultrasound 1976; 4:3.

[7] Feigenbaum H. Echocardiography. Philadelphia: Lea and Febiger, 1976.

[8] Hagen-Ansert SL. Textbook of diagnostic ultrasound. St. Louis: The CV Mosby Company, 1978.

[9] Grossman W, ed. Cardiac catheterization and angiography. Philadelphia: Lea and Febiger, 1980.

[10] Clark RD. Case studies in echocardiography. Philadelphia: WB Saunders Company, 1977.

Appendix 5. Obstetrics Calculation Methods

General Information

The Obstetrics function performs all calculations by means of tables and formulas. In this Appendix, the built-in methods *Hansmann, Tokyo*, *Robinson*, *Kurtz, Hobbins, Hadlock, Campbell, Hellman*, *Jeanty*, *Warsof, Shepard and Eik-Nes* are documented by means of the tables and formulas used.

References for the method tables and formulas are given at the end of this Appendix.

The method tables are adapted from the data given in the references by means of regression equations.

The Average of Gestational Age (avg_{GA})

$$avg_{GA} = \left(\frac{\sum_{i=1}^{n} (GA_i)}{n} \right)$$

The Average of Expected Day of Confinement (avg_{EDC}).

(avg_{EDC}) = date of examination + (GestationPeriod - GA)

Hansmann

BPD [mm]	**GA** [Days]	**BPD** [mm]	**GA** [Days]
25	87	65	174
30	96	70	185
35	107	75	197
40	117	80	211
45	127	85	227
50	138	90	242
55	151	95	260
60	162	100	278

Table 5.1. Hansmann. Gestational age (GA) calculated from biparietal diameter (BPD)

CRL [mm]	**GA** [Days]	**CRL** [mm]	**GA** [Days]
6	43	70	94
10	49	80	99
20	62	90	104
30	72	100	110
40	79	110	116
50	85	120	123
60	90	130	132

Table 5.2. Hansmann. Gestational age (GA) calculated from crown-rump length (CRL)

FL [mm]	**GA** [Days]	**FL** [mm]	**GA** [Days]
10	90	45	174
15	101	50	189
20	112	55	203
25	123	60	218
30	135	65	234
35	147	70	252
40	161	75	273

Table 5.3. Hansmann. Gestational age (GA) calculated from femur length (FL)

GS [mm]	GA [Days]	GS [mm]	GA [Days]	GS [mm]	GA [Days]
6	28	24	49	50	69
10	35	34	56	58	77
16	42	44	64	64	84

Table 5.4. Hansmann. Gestational age (GA) calculated from the size of the gestational sac (GS)

OFD [mm]	GA [Days]	OFD [mm]	GA [Days]
40	107	80	176
45	114	85	185
50	122	90	196
55	131	95	208
60	141	100	222
65	150	105	238
70	158	110	258
75	167	115	281

Table 5.5. Hansmann. Gestational age (GA) calculated from fronto-occipital distance (OFD)

TT [mm]	GA [Days]	TT [mm]	GA [Days]
25	92	65	186
30	102	70	197
35	114	75	209
40	126	80	221
45	139	85	234
50	152	90	247
55	163	95	259
60	175	100	268

Table 5.6. Hansmann. Gestational age (GA) calculated from transversal thorax (TT)

THAP [mm]	GA [Days]	THAP [mm]	GA [Days]
25	96	65	192
30	108	70	204
35	120	75	215
40	132	80	226
45	144	85	238
50	156	90	251
55	168	95	268
60	180	99	286

Table 5.7. Hansmann. Gestational age (GA) calculated from thorax anterior-posterior (THAP)

HC [mm]	GA [Days]	HC [mm]	GA [Days]	HC [mm]	GA [Days]
140	116	220	161	300	209
150	121	230	167	310	218
160	126	240	172	320	229
170	132	250	177	330	242
180	138	260	183	340	257
190	144	270	188	350	276
200	150	280	194		
210	155	290	201		

Table 5.8. Hansmann. Gestational age (GA) calculated from head circumference (HC)

Hansmann Calculations

HC calculated from measuring BPD and OFD (measured in cm)

$$\mathrm{HC} = 2.325 \times \sqrt{\mathrm{BPD}^2 + \mathrm{OFD}^2}$$

Fetal Weight using BPD and TT (measured in cm)

$$\mathrm{FW(g)} = [(-1{,}05775 \times BPD) + (0{,}649145 \times TT) + (0{,}0930707 \times BPD^2) - (0{,}020562 \times TT^2) + 0{,}515263] \times 1000$$

Tokyo

BPD [mm]	GA [Days]	BPD [mm]	GA [Days]	BPD [mm]	GA [Days]
20	84	53	153	79	222
24	91	56	161	82	232
27	98	59	168	84	240
31	105	62	176	85	244
34	112	65	184	87	254
38	120	67	189	88	259
41	127	70	197	89	266
44	133	72	202	90	272
47	139	75	210	91	280
50	146	77	216		

Table 5.9. Tokyo. Gestational age (GA) calculated from biparietal diameter (BPD)

CRL [mm]	GA [Days]	CRL [mm]	GA [Days]	CRL [mm]	GA [Days]
15	56	46	84	98	112
19	62	57	91	103	119
27	70	72	98		
36	77	87	105		

Table 5.10. Tokyo. Gestational age (GA) calculated from crown-rump length (CRL)

FL [mm]	GA [Days]	FL [mm]	GA [Days]	FL [mm]	GA [Days]
31	140	48	189	62	237
33	147	50	195	64	246
35	154	52	201	65	250
38	162	55	211	67	261
40	167	57	218	68	266
43	175	59	225	69	273
46	183	60	229	70	280

Table 5.11. Tokyo. Gestational age (GA) calculated from femur length (FL)

GS [mm]	GA [Days]	GS [mm]	GA [Days]	GS [mm]	GA [Days]
10	28	27	48	48	70
16	35	34	56	57	77
22	42	41	63	67	84

Table 5.12. Tokyo. Gestational age (GA) calculated from gestational sac (GS)

VL [mm]	GA [Days]	VL [mm]	GA [Days]	VL [mm]	GA [Days]
37	148	59	196	75	246
40	153	62	203	77	255
44	161	64	208	78	260
47	167	67	217	79	266
50	174	69	223	80	272
54	184	71	230	81	278
57	191	73	237		

Table 5.13. Tokyo. Gestational age (GA) calculated from length of vertebrae (VL)

Robinson

BPD [mm]	GA [Days]	BPD [mm]	GA [Days]	BPD [mm]	GA [Days]
20	85	48	143	76	216
24	93	52	153	80	228
28	101	56	162	84	240
32	109	60	172	88	253
36	118	64	182	92	266
40	126	68	193	96	280
44	135	72	204	100	294

Table 5.14. Robinson. Gestational age (GA) calculated from biparietal diameter (BPD)

CRL [mm]	GA [Days]	CRL [mm]	GA [Days]	CRL [mm]	GA [Days]
4	42	32	71	60	88
8	48	36	74	64	90
12	53	40	76	68	92
16	58	44	79	72	94
20	61	48	81	76	96
24	65	52	84	80	98
28	68	56	86		

Table 5.15. Robinson. Gestational age (GA) calculated from crown-rump length (CRL)

Kurtz

BPD [mm]	GA [Days]	BPD [mm]	GA [Days]	BPD [mm]	GA [Days]
27	98	57	161	81	224
31	106	60	168	83	231
34	111	63	175	85	237
38	119	66	182	87	245
41	125	69	190	89	252
45	134	71	195	91	261
48	140	74	203	92	265
51	147	76	209	94	274
54	154	79	218	95	279

Table 5.16. Kurtz. Gestational age (GA) calculated from biparietal diameter (BPD)

Hobbins

BPD [mm]	GA [Days]	BPD [mm]	GA [Days]	BPD [mm]	GA [Days]
10	71	45	132	80	220
15	78	50	143	85	235
20	86	55	154	90	251
25	94	60	166	95	267
30	103	65	179	99	280
35	112	70	192		
40	122	75	206		

Table 5.17. Hobbins. Gestational age (GA) calculated from biparietal diameter (BPD)

CRL [mm]	GA [Days]	CRL [mm]	GA [Days]	CRL [mm]	GA [Days]
5	44	23	64	41	77
7	47	25	66	43	78
9	50	27	67	45	79
11	52	29	69	47	81
13	55	31	70	49	82
15	57	33	72	51	83
17	59	35	73	54	85
19	61	37	74		
21	62	39	76		

Table 5.18. Hobbins. Gestational age (GA) calculated from crown-rump length (CRL)

FBL [mm]	GA [Days]	FBL [mm]	GA [Days]	FBL [mm]	GA [Days]
8	89	35	161	54	232
11	96	37	167	55	237
14	103	39	174	57	246
17	110	41	179	58	252
19	115	43	186	59	257
22	122	45	195	60	262
25	131	47	202	61	268
27	136	49	210	62	273
30	145	51	219	63	279
32	151	52	223		

Table 5.19. Hobbins. Gestational age (GA) calculated from fibula length (FBL)

PL [mm]	GA [Days]	PL [mm]	GA [Days]	PL [mm]	GA [Days]
7	77	34	142	61	218
10	88	37	149	64	227
13	97	40	156	67	236
16	105	43	164	70	244
19	112	46	172	73	253
22	118	49	181	76	261
25	124	52	190	79	269
28	130	55	199	82	277
31	136	58	208		

Table 5.20. Hobbins. Gestational age (GA) calculated from pes length (PL)

TBL [mm]	GA [Days]	TBL [mm]	GA [Days]	TBL [mm]	GA [Days]
7	84	32	153	54	226
10	92	35	162	55	230
12	98	37	167	57	239
15	105	40	176	58	244
17	111	42	182	60	253
20	120	44	189	61	258
22	125	46	195	63	267
25	134	48	202	64	272
27	139	50	210	66	281
30	148	52	218		

Table 5.21. Hobbins. Gestational age (GA) calculated from tibia length (TBL)

Hadlock

BPD [mm]	GA [Days]	BPD [mm]	GA [Days]	BPD [mm]	GA [Days]
20	86	48	144	76	215
24	93	52	153	80	227
28	101	56	162	84	240
32	109	60	172	88	253
36	118	64	182	92	266
40	126	68	193	96	280
44	135	72	204	100	294

Table 5.22. Hadlock. Gestational age (GA) calculated from biparietal diameter (BPD)

CRL [mm]	GA [Days]	CRL [mm]	GA [Days]	CRL [mm]	GA [Days]
2	40	34	72	66	90
6	45	38	75	70	92
10	50	42	78	74	94
14	54	46	80	78	97
18	58	50	82	82	100
22	62	54	84	86	102
26	66	58	86	87	104
30	69	62	88		

Table 5.23. Hadlock. Gestational age (GA) calculated from crown-rump length (CRL)

FL [mm]	**GA** [Days]	**FL** [mm]	**GA** [Days]	**FL** [mm]	**GA** [Days]
7	85	38	153	62	223
10	91	41	161	64	230
14	99	44	169	66	237
17	105	46	174	68	245
20	111	49	183	70	252
24	120	51	189	72	260
27	127	54	198	74	268
30	133	56	204	75	272
33	141	58	210	77	280
35	145	60	217		

Table 5.24. Hadlock. Gestational age (GA) calculated from femur length (FL)

HC [mm]	**GA** [Days]	**HC** [mm]	**GA** [Days]	**HC** [mm]	**GA** [Days]
70	85	201	154	301	224
84	91	213	161	308	231
97	97	224	168	315	239
110	104	235	175	322	246
124	111	246	182	328	254
138	119	256	188	333	260
151	126	266	195	338	267
164	134	275	202	342	272
177	141	284	209	346	278
189	148	293	217		

Table 5.25. Hadlock. Gestational age (GA) calculated from head circumference (HC)

AC [mm]	GA [Days]	AC [mm]	GA [Days]	AC [mm]	GA [Days]
50	86	162	147	281	225
55	88	174	154	291	232
60	91	185	160	300	239
65	93	197	168	309	245
73	97	208	175	318	252
86	104	219	182	327	259
99	111	230	190	336	266
112	118	240	196	344	272
125	125	251	204	353	279
137	132	261	211		
150	139	271	218		

Table 5.26. Hadlock. Gestational age (GA) calculated from abdominal circumference (AC)

Hadlock Calculations

Fetal Weight using AC and FL (measured in cm):

$$\log FW(g) = 1{,}3598 + 0{,}051(AC) + 0{,}1844(FL) - 0{,}0037(AC \times FL)$$

Fetal Weight using BPD, AC and FL (measured in cm):

$$\log FW(g) = 1{,}4787 - 0{,}003343 \times (AC \times FL) + 0{,}001837 \times (BPD)^2 + 0{,}0458 \times (AC) + 0{,}158 \times (FL)$$

Campbell

BPD [mm]	GA [Days]	BPD [mm]	GA [Days]
20	88	60	165
25	94	65	177
30	102	70	188
35	111	75	201
40	121	80	215
45	132	85	232
50	143	90	253
55	154	95	280

Table 5.27. Campbell. Gestational age (GA) calculated from biparietal diameter (BPD)

CRL [mm]	GA [Days]	CRL [mm]	GA [Days]	CRL [mm]	GA [Days]
10	49	37	73	64	89
13	52	40	75	67	90
16	55	43	77	70	92
19	58	46	79	73	93
22	61	49	81	76	95
25	63	52	82	79	96
28	66	55	84	82	97
31	69	58	86	85	98
34	71	61	87		

Table 5.28. Campbell. Gestational age (GA) calculated from crown-rump length (CRL)

FL [mm]	GA [Days]	FL [mm]	GA [Days]
10	89	45	175
15	101	50	189
20	112	55	204
25	123	60	220
30	135	65	238
35	148	70	259
40	161	75	287

Table 5.29. Campbell. Gestational age (GA) calculated from femur length (FL)

HC [mm]	**GA** [Days]	**HC** [mm]	**GA** [Days]
100	96	250	187
125	112	275	204
150	127	300	225
175	143	325	252
201	158	350	288
225	172		

Table 5.30. Campbell. Gestational age (GA) calculated from head circumference (HC)

AC [mm]	**GA** [Days]	**AC** [mm]	**GA** [Days]	**AC** [mm]	**GA** [Days]
84	100	180	159	280	224
96	107	192	167	292	232
108	114	208	177	304	240
120	122	220	185	316	248
132	129	232	192	328	256
144	137	244	200	336	262
156	144	256	208		
168	152	268	216		

Table 5.31. Campbell. Gestational age (GA) calculated from abdominal circumference (AC)

AC [mm]	**FW** [g]	**AC** [mm]	**FW** [g]	**AC** [mm]	**FW** [g]
210	899	280	2081	350	3472
220	1032	290	2283	360	3639
230	1179	300	2489	370	3789
240	1339	310	2695	380	3918
250	1510	320	2899	390	4023
260	1692	330	3098	400	4099
270	1883	340	3290		

Table 5.32. Campbell. Fetal weight (FW) calculated from abdominal circumference (AC)

Hellman

GS [mm]	GA [Days]	GS [mm]	GA [Days]	GS [mm]	GA [Days]
10	35	28	53	46	71
12	37	30	55	48	73
14	39	32	57	50	75
16	41	34	59	52	77
18	43	36	61	54	79
20	45	38	63	56	81
22	47	40	65	58	83
24	49	42	67	60	85
26	51	44	69		

Table 5.33. Hellman. Gestational age (GA) calculated from the size of the gestational sac (GS)

Jeanty

BPD [mm]	GA [Days]	BPD [mm]	GA [Days]	BPD [mm]	GA [Days]
28	98	52	146	76	206
30	102	54	151	78	212
32	106	56	155	80	218
34	109	58	160	82	224
36	113	60	164	84	231
38	117	62	169	86	237
40	121	64	174	88	244
42	125	66	179	90	250
44	129	68	185	92	257
46	133	70	190	95	268
48	137	72	195		
50	142	74	201		

Table 5.34. Jeanty. Gestational age (GA) calculated from biparietal diameter (BPD)

CRL [mm]	**GA** [Days]	**CRL** [mm]	**GA** [Days]	**CRL** [mm]	**GA** [Days]
5	44	23	64	41	77
7	47	25	66	43	78
9	50	27	67	45	79
11	52	29	69	47	81
13	55	31	70	49	82
15	57	33	71	51	83
17	59	35	73	54	85
19	61	37	74		
21	62	39	76		

Table 5.35. Jeanty. Gestational age (GA) calculated from crown-rump length (CRL)

AC [mm]	**GA** [Days]	**AC** [mm]	**GA** [Days]	**AC** [mm]	**GA** [Days]
57	84	163	154	262	223
67	91	173	161	271	231
77	98	184	168	279	238
88	105	195	175	286	245
98	112	205	182	293	252
109	119	215	189	300	260
119	126	225	196	306	267
130	133	235	203	311	273
141	140	244	210	316	280
152	147	254	217		

Table 5.36. Jeanty. Gestational age (GA) calculated from abdominal circumference (AC)

Eik-Nes

BPD [mm]	GA [Days]	BPD [mm]	GA [Days]	BPD [mm]	GA [Days]
35	105	74	189	99	273
38	112	76	196	100	280
41	119	80	203		
44	126	82	210		
47	133	85	217		
50	140	87	224		
54	147	89	231		
57	154	91	238		
61	161	93	245		
64	167	95	252		
67	174	97	259		
71	181	98	266		

Table 5.37. Eik-Nes. Gestational age (GA) calculated from biparietal diameter (BPD)

Eik-Nes Calculation

Fetal Weight using ATD and BPD (measured in mm)

$$FW = 1{,}43149 \times 0{,}001 \times \mathrm{BPD}^{1{,}85628} \times \mathrm{ATD}^{1{,}34008}$$

Williams

FW [g]	GA [Days]	FW [g]	GA [Days]
513	154	2394	238
589	161	2628	245
675	168	2849	252
772	175	3052	259
881	182	3226	266
1005	189	3364	273
1143	196	3461	280
1297	203		
1483	210		
1694	217		
1920	224		
2155	231		

Table 5.38.Williams. Fetal weight (FW) calculated from gestational age (GA)

Persson

FW [g]	GA [Days]	FW [g]	GA [Days]
464	154	2381	238
567	161	2586	245
682	168	2791	252
809	175	2995	259
947	182	3197	266
1097	189	3394	273
1256	196	3583	280
1426	203		
1603	210		
1789	217		
1982	224		
2180	231		

Table 5.39.Persson. Fetal weight (FW) calculated from gestational age (GA)

Osaka

FW [g]	GA [Days]	FW [g]	GA [Days]
512	154	2254	238
611	161	2428	245
720	168	2600	252
839	175	2767	259
968	182	2928	266
1106	189	3080	273
1253	196	3220	280
1407	203		
1568	210		
1735	217		
1906	224		
2079	231		

Table 5.40.Osaka. Fetal weight (FW) calculated from gestational age (GA)

Shepard

Shepard Calculation

Fetal Weight using BPD and AC (measured in cm)

$$\log FW(g) = 1{,}2508 + (0{,}166 \times BPD) + (0{,}046 \times AC) - 0{,}00264 \times BPD \times AC$$

Warsof

Warsof Calculation

Fetal Weight using BPD and AC (measured in cm):

$$\log FW(g) = 1{,}401 + 0{,}144 \times BPD + 0{,}032 \times AC - \frac{0{,}111(BPD^2 \times AC)}{1000}$$

Accuracy of Calculations

Factors Affecting Accuracy

The input parameters used in the obstetrics calculations are measured distances (for example, BPD), measured circumferences (for example, AC) or an entered LMP date. These parameters are used to calculate fetal weight (FW), gestational age (GA) and expected date of confinement (EDC).

The calculation accuracy is influenced by:

- the accuracy of the measured input parameters
- the accuracy of the calculation methods
- rounding.

Accuracy of Measured Input Parameters

The measurement accuracy of distances or circumferences is stated for each transducer type on the Technical Data CD (BZ2100).

Accuracy of Calculation Methods

Errors introduced by the calculation methods are **not** taken into account as **system errors** - they depend statistically on a specific study and population. These errors are highlighted in the references [11–30].

Rounding

Rounded numbers are shown on the monitor and in the OB report, but internally, floating point values are used to calculate FW and GA. Thus rounding errors in calculations are negligible compared to the other error sources.

Note: It is the responsibility of the physician to evaluate accuracies in each specific patient case.

References

[11] Hansmann v. Hackelöer. Ultraschalldiagnostik in der geburtshilfe und Gynäkologie. 1984.

[12] Hansmann et al. Geburtshilfe u. Frauenheilk. 1979;39:656.

[13] Data from Prof. Campbell's Dept., Kings College Hospital London SE5.

[14] Robinson H, Flemming J. British Journal of Obstetrics and Gynaecology. 1975;82:702.

[15] Hadlock et al. J. Ultrasound Med. 1982;1:97–104.

[16] Hadlock et al. Radiology. 1984;152:497–501.

[17] Hadlock et al. Radiology. 1992;182:501–505.

[18] Hadlock et al. Radiology. 1984;150:535–540.

[19] Hobbins et al. American Journal of Obstetrics and Gynecology. 1982;142:47-54.

[20] Hobbins et al. American Journal of Obstetrics and Gynecology. 1982;144:289–297.

[21] Hobbins et al. Prenatal Diagnosis of Congenital Anomalies. 1988.

[22] Hadlock et al. J. Ultrasound Med. 1991;10:557–561.

[23] Hadlock et al. J. Clinical Ultrasound. 1983;11:313–316.

[24] Shepard MJ et al. American Journal of Obstetrics and Gynecology. 1982;147:47–54.

[25] Hellmann LM, et al. American Journal of Obstetrics and Gynecology. 1969;103:784-800.

[26] Kurtz AB, et al. J. Clin. Ultrasound. 1980;8:319.

[27] Jeanty & Romero, Obstetrics Ultrasound. 1984.

[28] Jeanty, Radiology. 1983;147:319-324.

[29] Warsof et al., American Journal of Obstetrics and Gynecology. 1977;128:881.

[30] Eik-Nes SH, Grøttum P. Estimation of fetal weight by ultrasound measurement. Development of a new formula. Acta Obstet et Gynecol Scand. 61:307– 312, 1982.

[31] Osaka University Journal of Fetal Growth (Japan) 37 1140-45 1988.

[32] Williams R.L. et al. Obstet. Gynecol. 59 (1982), 624-632.

[33] Persson PH, Obstetrisk Ultralyd 36 92-93 1997 (Swedish Working Group in Gynecology ULTRAARG).

Index

A

accuracies
  clinical measurements explained *Front-xvii*
accuracy
  2D geometric measurements *Front-xix*
  time difference measurements *Front-xix*
acoustic output *Front-xii–Front-xvii*
  data on CD *Front-i*
  default *Front-xvi*
  factors affecting *Front-xvi*
  limits *Front-xiv–Front-xv*
  measurement *Front-xv–Front-xvi*
adenoma *C-1*, *C-10*
aligning the matrix *A-19*
angle measurements *B-8–B-9*
aortic root diameter (AOD) *F-6*
aortic valve diameter (AVD) *F-6*
aortic valve study *F-6*
arrow *A-27*
aspect ratio of flat screen, changing *A-4*
auto calculation *A-16*
auto measure *A-16*
auto menu *A-16*
automatic planimetry *C-5–C-7*
  formula *App-10–App-11*
  with the draw function *C-6*
  with the ellipse function *C-6*
auxiliary power outlets *H-5*
  and leakage current requirements *Front-xii*

B

B gain *B-1*, *B-6*
B+M-mode *B-3*
beat volume *D-2*, *F-2*
bioprofile *E-21*
  parameters *E-21*
  score *E-22*
bladder *C-1*
B-mode
  contrast *B-2*
  frame rate *B-2*
  gain *B-1*, *B-6*
  gray scale *B-2*
  image *B-2*
  persist *B-2*
  strong focus *B-3*
  TGC *B-1*
bodymark *A-38–A-41*
brightness, adjusting
  screen *A-3*

C

cable
  shelf *H-22*
  spiral *H-21*
  tidying *H-21*
calculator *A-16*, *B-5*
Campbell tables *App-31–App-32*
cardiac calculations
  accuracies *App-17–App-19*
  definitions *D-1*
  formulas *App-15–App-17*
  reports *D-4*
cardiac measurements *D-1–D-5*
  circumference *D-4*
  distance *D-3*
CD, technical data *Front-i*, *Front-xvii*
CE marking *Front-iv*
circle *B-11*
cleaning *J-2*, *J-3*
composite focus *B-3*
Composite in *H-11*
Composite out *H-11*
configuration switch *H-17*
  language selection *H-17*
  RS232 A mode *H-17*

Index

switch 1 *A-20*
connecting other equipment *Front-xi*, *H-5*
connector plug *J-3*
contour *B-2*
contrast *B-2*
copy control *A-29*
customizing your system *A-11–A-25*

D

date format *A-22*
default measure settings *A-14*
delete *A-27*
diastolic internal diameter (IDd) *F-4*
DICOM
setup *A-16*
discharge fraction *D-2*, *F-2*
disinfection/sterilization *J-2*
dismantling for transportation *H-23*
disposal of scanner *J-7*
distance
line pattern *A-17*
distance measurements *A-33*, *B-5*, *B-8*
distance measurments
display *A-17*
D-M-C Gain *B-4*
docking flat screen monitor *A-2*
documentation equipment
options *H-12*
documentation shelf *H-20*
documentation trigger *H-9*
pin configuration *H-8*
socket *H-7*
draw *B-9*
dust protection *Front-iv*

E

Eik-Nes Calculation *App-35*
Eik-Nes fetal weight equation *App-35*
Eik-Nes tables *App-34*
ejection time (ET) *F-4*
electromagnetic compatibility. See EMC.
ellipse *B-11*
EMC
data on CD *Front-i*
noise, checking for *Front-ix*
empirical method *C-8–C-9*
formula *App-11*
with the draw function *C-8*
with the ellipse function *C-9*
ESD
symbol *Front-vii*
training *Front-vii*
ethylene oxide gas *J-5*
expected FW *E-7*, *E-11*

F

F1 - F5 controls *A-6*
fetal growth trend *E-4*, *E-21*
fetal weight
expected *E-11*
methods *E-11*
user-defined *E-15*
user-defined equations *E-16*, *E-17*
focal zones *B-3*
focus
composite *B-3*
strong *B-3*
foot switch *A-42*
left pedal function *A-23*, *A-42*
pin configuration *H-16*
socket *H-16*
frame rate
B-mode *B-2*
freeze control *A-27*

Index

front panel
adjustment *A-1*
height *A-1*
removal *A-1*
full reset *A-47*
fuses *H-3*, *H-9*

G

GA curve *E-20*
regression curves *E-20*
gain
B-mode *B-1*, *B-6*
M-mode *B-4*
gamma settings of flat screen, changing *A-4*
gestational age
by ultrasound *E-1*
clinical *E-1*
curve *E-20*
gray scale
mapping curve *B-2*
gray scale, adjusting
B-mode *B-2*
M-mode *B-4*

H

Hadlock fetal weight calculations *App-30*
Hadlock tables *App-28–App-30*
Hansmann tables *App-21–App-23*
heart rate (HR) *B-12–B-13*, *D-3*, *F-2*
Hellman tables *App-33*
Hobbins tables *App-26–App-28*
horizontal split screen *A-14*
hospital identification *A-20*
HWL *B-7*
formula *App-9*
volume calculation *C-2*

I

IDC *A-32*
image
automatic review *B-13*
control *B-2*
DICOM *A-16*
orientation *A-37*
review *B-13*
size controls *A-29*
installation *H-1–H-21*
interface kit for VCR *H-8*
international characters *App-3*, *App-4*

J

Jeanty tables *App-33–App-34*

K

keyboard
cleaning *J-1*
disinfection *J-2*
keyboard controls
Puncture *A-17*
keyboard controls guide *A-26*
keyboard functions *App-2*
keyboard shortcuts *App-1*
kidney *C-1*
Kurtz tables *App-26*

L

label *A-33–A-37*
library *A-35*
setup functions *A-35*
LAD to AOD ratio (LAR) *F-6*
language *A-20*
selection *H-17*
last menstrual period (LMP) *E-3*, *E-4*
leakage current *Front-vi*
left atrium diameter (LAD) *F-6*
left ventricle study *F-4*

M

main voltage *H-2*

Index

maintenance
  palm control unit *J-6*
  scanner *J-6*
  transducer *J-7*
manual planimetry formula *App-10*
matrix alignment *A-19*
measure *B-6–B-13*
  angle *B-8–B-9*
  circle *B-11*
  distance *B-5*, *B-8*
  draw *B-9*
  ellipse *B-11*
  heart rate (HR) *B-12–B-13*
  in split screen mode *B-6*
  volume *B-9–B-10*
measurements
  distance *A-33*
mechanical index *Front-xiv*
  limit *Front-xiv*
mechanical transducers
  mechanical index *Front-xiv*
menu options *A-7*
menu time-out *A-21*
Menu window (for flat screen settings) *A-4*
MFI (Multi-Frequency Imaging) *A-28*
MI limit *Front-xiv*
mitral valve study *F-5–F-6*
m-line *A-32*
M-mode
  gain *B-4*
  gray scale *B-4*
  sweep speed *B-5*
M-mode calculation
  accuracies *App-19*
  formulas *App-16–App-17*
  reports *F-7*
M-mode calculation measurements *F-1–F-8*
  aortic root diameter (AOD) *F-6*
  aortic valve diameter (AVD) *F-6*
  aortic valve study *F-6*
  diastolic internal diameter (IDd) *F-4*
  ejection time (ET) *F-4*
  LAD to AOD ratio (LAR) *F-6*
  left atrium diameter (LAD) *F-6*
  left ventricle study *F-4*
  mitral valve study *F-5–F-6*
  right ventricular outflow tract diameter (RVOT) *F-6*
  systolic internal diameter (IDs) *F-4*
monitor
  adjusting *A-2*
  adjusting height *A-2*
  adjusting viewing angle *A-2*
  docking flat screen *A-2*
monitor (LCD flat screen)
  removing for transportation *H-23*
  replacing *H-23*
monitor base
  removing for transportation *H-24*
  replacing *H-24*
monitor display *Front-xiv*, *A-7*

N

needle guidance
  ruler with 8658 *A-31*
noise
  EMC *Front-ix*

O

obstetric calculations
  accuracies *App-37–App-38*
  methods *E-1*
  methods (tables) *App-20–App-38*
  shortcuts *A-24*
  user setup *E-8–E-9*
  user-defined methods *E-13–E-19*
obstetric measurements *E-2–E-7*
  circumference *E-6–E-7*
  distance *E-5–E-6*

Index

LMP *E-3*, *E-4*
obstetric reports *E-19*
orientation control *A-37*
Osaka fetal weight method *E-11*, *App-36*

P

palm control unit *A-1*, *A-43*–??
cleaning *J-2*
connecting *H-18*–*H-20*
connection *A-9*
disinfection *J-3*
functions *App-5*
maintenance *J-6*
mouse stick *A-6*, *A-43*
partial reset *A-47*
patient ID *A-46*
PCU
see palm control unit
perineal puncture line *A-31*
persist
B-mode *B-2*
Persson fetal weight method *E-11*, *App-36*
planimetry
formula for automatic *App-10*
formula for manual *App-10*
planimetry calculation *C-3*–*C-5*
starting point *C-3*
with the draw function *C-4*
with the ellipse function *C-4*–*C-5*
plug covers
watertight *J-3*
pointer *A-27*, *App-5*
potential equalization terminal *H-6*
probe saver *A-21*
Product Data sheet *Front-i*, *J-2*, *J-3*
prostate *C-1*
protective earth
additional *H-6*
PSA density formula *App-12*
PSA level *C-10*
puncture *A-31*
Puncture control *A-17*

R

RGBS
in socket *H-11*
out socket *H-11*
pin configuration *H-13*
sockets *H-13*
right ventricular outflow tract diameter (RVOT) *F-6*
Robinson tables *App-25*–*App-26*
rotation axis, in volume measurements *B-9*, *B-11*
rotation axis, Type 8551 *A-38*
RS232
A mode *H-17*
connection *H-9*
sockets *H-6*
ruler with 8658 *A-31*

S

safety information *Front-ii*–*Front-iv*
scanner
disposal *J-7*
maintenance *J-6*
removal of front panel *H-23*
removing LCD flat screen monitor *H-23*
removing monitor base *H-24*
transportation *H-23*
scanning plane *A-39*
screen brightness, adjusting *A-3*
screen saver *A-21*
seed matrix shortcut *A-31*
select *A-27*
selecting the date format *A-22*
service and repair *Front-xi*
Shepard calculation *App-37*

Index

Shock Wave Device
  setup *A-12*
shortcut setup *A-23*
  urology parameters *A-25*
shortcuts
  user-defined *App-2*
simultaneous split screen *A-30*
soft keys *A-7*
soft menu *A-7*
split screen *A-29*
  biplane transducer *A-30*
  horizontal split screen *A-14*
  simultaneous *A-30*
STERIS SYSTEM *J-4*
STERRAD *J-4*
storage of equipment *J-5*
strong focus *B-3*
S-VHS In socket *H-12*
S-VHS sockets *H-11*, *H-12*
sweep speed
  M-mode *B-5*
symbols
  back and front of scanner *H-8*
system setup *A-15*, *App-6*
  DICOM *A-16*
systolic internal diameter (IDs) *F-4*

T

technical data CD *Front-i*, *Front-xvii*
testis *C-1*
TGC (Time Gain Compensation) *B-1*
thermal index *Front-xiv*, *Front-xv*, *B-4*
  adjusting *B-4*
  limit *Front-xvi*, *B-4*
TI limit *Front-xiv*
time display
  12 or 24 hour clock *A-22*
time measurements *Front-xix*
tissue type *B-4*
Tokyo tables *App-24–App-25*
trackball *A-26*
  adjustment *A-26*
  cleaning *J-2*
transducers
  saving your setup *A-11*
  selecting *A-10*
  selecting for Type 1850 *A-10*
  setup *A-12*
  single element *A-9*
Transition Zone Index
  see TZ Index *C-10*
TV standard *H-17*
TZ Index *C-10*
  calculations *C-10*

U

urology
  reports *C-10*
  shortcuts *A-25*
urology calculations
  accuracy *App-12–App-13*
  formulas *App-9–App-14*
urology measurements *C-1–C-9*
  automatic planimetry *C-5–C-7*
  empirical method *C-7–C-9*
  HWL *C-2*
  planimetry *C-3–C-5*
user-defined FW method *E-15*

V

VGA sockets *H-14*
  pin configuration *H-15*
video cassette recorder *H-8*
  interface kit *H-8*
video documentation equipment *H-10*
video settings *A-23*
volume *B-9–B-10*, *B-11*
  with the circle function *B-12*

with the draw function *B-9–B-10*
with the ellipse function *B-11*

W

Warsof calculation *App-37*
water-tight plug covers *J-3*
Williams fetal weight method
E-11, *App-35*

X

xmit power *A-32*

Z

zoom *A-28*
initial mode *A-15*
levels *A-28*
panning *A-28*

Index